

The AMSAT[®] Journal

Editor-in-Chief:
Ed Long, WA4SWJ

Editorial Staff:
John Bubbers, W1GYD
Bill Hook, W3QBC

Volume 27, Number 4

July/August 2004

Echo is in Orbit!



in this issue

New Echo/AO-51 Book	2
<i>by G. Gould Smith, • WA4SXM</i>	
Apogee View	3
<i>by Robin Haighton • VE3FRH</i>	
AMSAT AGM	5
<i>Help support AMSAT</i>	
From Echo to AO-51	6
<i>by Lee McLamb • KU4OS</i>	
The Echo Launch Campaign	7
<i>by Chuck Green • N0ADI</i>	
Echo Named AO-51	9
<i>by Bill Tynan • W3XO</i>	
Field Day - W3SH Station	9
<i>by Jim Sanford • WB4GCS</i>	
Quickie S-Band Helix	10
<i>by Gunther Meisse • W8GSM</i>	
AMSAT Field Day Results	11
<i>by Bruce Paige • KK5DO</i>	
Amateur Radio on the ISS	12
Phase 2 Hardware System	
<i>by Frank Bauer • KA3HDO, et al</i>	
SO-50 Open	17
<i>by Robin Haighton • VE3FRH</i>	
P3E Status Update	18
<i>by Peter Gülzow • DB2OS</i>	
AMSAT at Dayton	19
2004 AGM Registration Form	21
S-Band Signal Source	22
<i>by Peter Carr • WW3O, et al</i>	
C-C Rider	24
<i>by Tom Clark • W3IWI</i>	
Sats are Simple!	29
<i>by Diane Bruce • VA3DB</i>	
AMSAT Donors	30
<i>by Robin Haighton • VE3FRH</i>	
Field Ops Update	34
<i>by Barry Baines • WD4ASW</i>	

AMSAT-NA
850 Sligo Avenue, Suite 600
Silver Spring, MD 20910-4730

Periodicals

POSTAGE PAID

At Silver Spring, MD
and at additional
mailing offices

How You Can Help Build New and Exciting Satellites

Donate to the President's Club

Gold, Silver, Bronze and Core levels are available to match your ability to participate.

Cash Gifts

Visa, or MasterCard or checks are accepted. And, you can specify how your contribution is to be used.

Gift of Life Insurance

US taxpayers may be able to receive a significant income tax deduction by making The Radio Amateur Satellite Corporation the owner and beneficiary of life insurance policies.

Gift of Stocks or other Securities

US taxpayers should be able to avoid capital gains taxes on appreciated securities and receive a deduction for their fair market value.

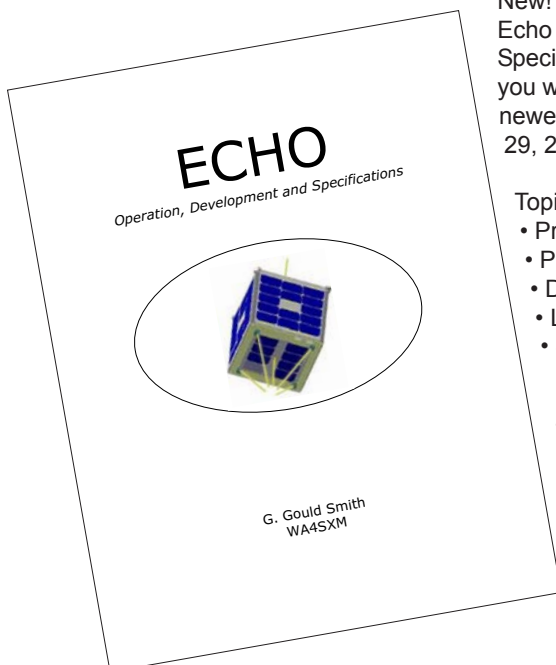
Bequest

A codicil in your will, naming The Radio Amateur Satellite Corporation as a beneficiary will help insure the continuance of the Amateur Radio Satellite program.

Call the AMSAT-NA office at 301-589-6062 for questions on any or all of these ways you can help build new and exciting satellites.

Support AMSAT-NA

New Echo/AO-51 Book Available from AMSAT!



New! Written by G. Gould Smith, WA4SXM. Echo Operation, Development and Specifications. Covers nearly everything you want to know about AMSAT-NA's newest satellite that was launched on June 29, 2004.

Topics:

- Preliminary operating instructions
- Preliminary orbital characteristics
- Development process of Echo/AO-51
- Launch information
- Specifications of most of the major satellite systems

To Order:

Write, telephone or fax:

AMSAT-NA
850 Sligo Ave., Suite #600
Silver Spring, MD, 20910
Telephone: 301-589-6062
Fax: 301-608-3410

Suggested donation: (mailed postpaid)
\$15 in the U.S., \$19 elsewhere

AMSAT's Mission

AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow Amateur Radio societies. We encourage technical and scientific innovation, and promote the training and development of skilled satellite and ground system designers and operators.

AMSAT's Vision

Our Vision is to deploy high earth orbit satellite systems that offer daily coverage by 2009 and continuous coverage by 2012. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.





Radio Amateur Satellite Corporation (AMSAT-NA)
850 Sligo Ave. #600, Silver Spring, MD 20910-4703
Telephone: 301-589-6062 – Toll Free: 888-322-6728

Facsimile: 301-608-3410

AMSAT-NA Club Callsign - W3ZM

AMSAT-NA website: <http://www.amsat.org>

The AMSAT Journal Staff

Editor-in-Chief: Ed Long, WA4SWJ
(wa4swj@amsat.org)

Circulation: Martha Saragovitz
(martha@amsat.org)

Editorial Staff:

John Bubbers, W1GYD; Bill Hook, W3QBC

AMSAT-NA Board of Directors

Tom Clark, W3IWI (Chairman); Robin Haighton, VE3FRH;

Bruce Paige, KK5DO; Barry Baines, WD4ASW;
Rick Hambly, W2GPS; Gunther Meisse, W8GSM;
Lou McFadin, W5DID;

Lee McLamb, KU4OS (First Alternate)

AMSAT-NA Officers

President:

Robin Haighton, VE3FRH

Executive Vice-President:

Rick Hambly, W2GPS

Vice-President, Operations:

Stacey Mills, W4SM

Vice-President, Engineering:

Stan Wood, WA4NFY

Manager, Orlando Laboratory:

Lou McFadin, W5DID

Vice-President, Human Space Flight:

Frank Bauer, KA3HDO

Vice-President, Field Operations:

Barry Baines, WD4ASW

Vice-President, User Services:

Bruce Paige, KK5DO

Vice-President, Electronic Publications:

Paul Williamson, KB5MU

Vice-President, Development:

Walter Wittenberg, K0CEH

Vice-President, Strategic Planning:

Bill Burden, WB1BRE

Vice-President, Publications:

Russ Tillman, K5NRK

Marketing Manager:

Jim Jarvis, N2EA

Founding President Emeritus & VP, Government

Liaison:

Perry Klein, W3PK

Treasurer:

Art Feller, W4ART

Corporate Secretary:

Martha Saragovitz

President Emeritus:

Tom Clark, W3IWI

Immediate Past President:

Keith Baker, KB1SF

Editorial Office: Ed Long, WA4SWJ, 611 Sugar Creek Road, Delavan, WI, 53115, e-mail Journal submissions to: journal@amsat.org, telephone: 262-374-1349. Advertising Office: AMSAT-NA Headquarters, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703.

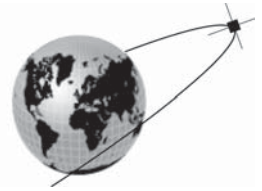
The AMSAT Journal (ISSN: 1407-3076) is published bi-monthly (Jan, Mar, May, Jul, Sep, Nov) by AMSAT-NA, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703. Telephone: 301-589-6062, fax: 301-608-3410. Periodicals postage paid at Silver Spring, MD and additional mailing offices. Postmaster: Send address changes to The AMSAT Journal, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703.

Opinions expressed in The AMSAT Journal are those of the article authors and are not necessarily those of AMSAT-NA. Copyright © 2004 by AMSAT-NA, The Radio Amateur Satellite Corporation. AMSAT is a registered trademark. Reproduction of material from The AMSAT Journal by mechanical, electronic, photocopy or other means is prohibited unless written permission is obtained from the author.

The AMSAT Journal staff is always interested in article submissions. Whenever possible, submissions should be sent via e-mail to journal@amsat.org using plain text or word processor files; photos or figures in TIF, GIF or JPEG formats. AMSAT-NA reserves the right to select material for The AMSAT Journal based on suitability of content and space considerations. The editors of this publication are volunteers giving freely of their talents, time and efforts to produce The AMSAT Journal.

APOGEE VIEW

by Robin Haighton, VE3FRH • ve3frh@amsat.org



The planning and development of a satellite program is an extremely complex issue, and the more technically complex that the satellite is then the more planning goes into the whole development of the program.

This may seem to be obvious as far as the technical requirements are concerned, but it is also true with regard to the biggest issue of satellite development "FUNDING".

Yes, the biggest problem is arranging the funds to build and launch a satellite, and the second biggest problem is finding a suitable launch at a suitable cost. Again, a funding problem.

It seems that for the past four years I have been constantly asking you for funds.

I make no apologies for this as AO-51 (Echo) is your satellite and you, AMSAT members around the world, have been generous by supplying all the funding effectively buying yourselves the satellite for your enjoyment. Now please do enjoy it, both as a ham satellite and as an experimental satellite. Wednesdays (UTC) are experimenters days and many experiments using high speed digital, the SQRX wide band receiver, S-band equipment transmitter, etc. will be tried.

AMSAT has an Echo operating committee that will determine the modes of operation for the satellite and will post these on the AMSAT Web page for your information.

Meanwhile the Board of Directors and officers must now turn their attention to Eagle and try to determine the optimum characteristics, which AMSAT can afford for this bird.

Your Board of Directors has already determined that Eagle will be a high Earth orbit satellite, possibly in a Geosynchronous Transfer Orbit (GTO) similar to AO-40.

As P3E from AMSAT-DL will also be in a high earth orbit, these two satellites could complement each other by making a substantial amount of time available each day to satellite operators around the world. Our one problem is, that positioning a satellite in HEO is very expensive. My current estimate is around \$2 Million just for the launch and up to another \$1 Million for the satellite (just my educated guess).

Can we do this? I think we can. We have 5 years to do it with your assistance, but it does mean that somehow we have to generate \$600,000 each and every year.

One way to do this would be for every member of AMSAT to become a subscribing member of the "Presidents Club" at the

Bronze or higher level (\$120/yr). Alternately we could raise the membership fee to \$150 per year. What do you think? With the President's Club you would get a tax letter (if you live in the USA) but with membership no tax letter would be available.

There is a great debate as to the modes that EAGLE should have available. Through the recent survey you have expressed a strong wish for mode U/V (70 cms up/2 m downlink). Each and every mode has its advantages and disadvantages. Perhaps the biggest advantage to this mode is that you are ready to use it and thus prefer it over other modes. Perhaps the biggest disadvantage is the antenna size for 2 meters. This is always a problem as satellites get smaller and smaller (read into that "easier to launch"). The amount of antenna space was a problem on AO-40 (6 feet in diameter). Now replace that with Eagle (a 2 foot or 60 cms cube) and you can see the problem. These are but some of the challenges that we have to face with Eagle. You can help by expressing your views to your representatives on the Board of Directors and voting for the Board candidate who is most likely to represent you.

The ballot has been mailed. Who gets on the Board of Directors is up to you. Whoever wins I will look forward to working with them.

On a different note, we are now approaching the Annual Meeting. See page 21 in this Journal for details. If you live anywhere near Washington DC and can make the meeting, I implore you to do so. It is the AMSAT meeting highlight of the year.

The Space Symposium will start on Friday, October 8 and continue to Saturday, October 10. The papers on satellite design, operating and experimenting are always worth attending. Every year I acquire a great deal of new information about different aspects of our hobby and I do encourage you all to attend. If these papers were read in a "for profit" meeting the charge would probably be over \$450 just to attend.

On Thursday, October 7, the Board of Directors will meet and elect a new slate of senior officers for 2004/2005. At that time I will retire as your President, after four years. More on this in the next Apogee View.

73,
Robin Haighton, VE3FRH
President



What is AMSAT®?

AMSAT members are a worldwide group of enthusiastic individuals designing, building and operating Amateur Radio satellites as part of our program of space science education.

The Radio Amateur Satellite Corporation (AMSAT or AMSAT-NA) is a non-profit scientific and educational organization chartered in Washington, DC, in 1969. Since then, AMSAT and colleague organizations around the world have built over 50 ham radio satellites. Fifteen of these satellites continue in operation.

Joining AMSAT supports our current projects: Eagle, AMSAT-OSCAR-E (Echo) and ARISS. Eagle is a high orbit DX capable satellite planned for a 2007 launch. Echo is a low orbit FM and digital bird you will be able to use with simple equipment, planned for launch in 2004. And ARISS is our program on the International Space Station. You will keep up to date on the world of Amateur Radio satellites with 6 issues of the AMSAT Journal every year.



We'd like to have you as a member!

AMSAT, 850 Sligo Avenue, Suite 600 Silver Spring, MD 20910-4703
Phone 888-322-6728 (Toll Free in USA) or 301-589-6062 * Fax 301-608-3410
email: martha@amsat.org http://www.amsat.org/

Join or Renew Today. Send to: AMSAT, 850 Sligo Ave #600, Silver Spring, MD 20910-4703
or call the AMSAT Office at 888-322-6728 (Toll Free in the USA) or 301-589-6062.

Name _____ Call _____
Street _____ Membership # _____
City _____ State/Prov _____ Zip/PC _____
Country _____ Visa/MC # _____ Exp. _____
Day Time Phone _____ Evening Phone _____
E-Mail _____
Referred by _____ Signature _____
Annual Membership: USA \$39, Canada/Mexico \$45, Elsewhere \$50 _____
Life Membership: \$720 Schools & Clubs: \$50/yr. _____
President's Club Donation: Gold, Silver, Bronze, Core _____
\$1200, \$600, \$300, \$120 per year _____
☐ Check here if you want to make 12 monthly Donations for the
President's Club each 1/12 of the Presidents Club total (Credit Card only).
Other donation (such as \$40, \$70, \$100, \$250, \$500) _____
TOTAL Membership Renewal and Donations in US \$ _____

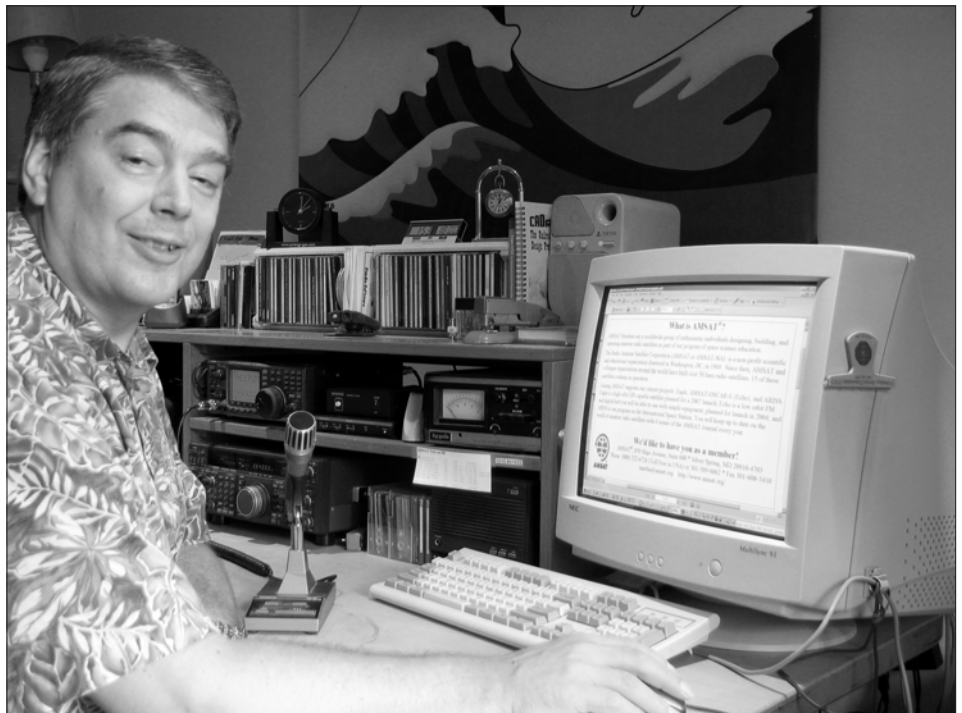
Do you send QSL cards for satellite contacts? You can help AMSAT by inserting the form above describing AMSAT and providing membership information when you send your QSL's. Put one of these inserts in with every QSL mailing and will help other hams find out about AMSAT and you will help AMSAT build new satellites by helping to add new members.

Included at the [amsat.org](http://www.amsat.org) Web site are forms for single sided printing ... just print, cut, fold and mail. You can also find forms for double sided printing if you prefer.

You can find the AMSAT QSL inserts online at:

<http://www.amsat.org/amsat/amsat-na/membership.html>

Rick Hambly (right), W2GPS, AMSAT Executive VP, is shown viewing the AMSAT QSL Insert. Add one to your QSL's and encourage your fellow hams to join AMSAT.





AMSAT®

35 years!



22nd Space Symposium and Annual Meeting **8-10 October 2004 — Arlington, Virginia**

held in conjunction with the

Amateur Radio on the International Space Station (ARISS) International Delegates Meeting — 10-13 October 2004

SPECIAL FEATURES:

Sunday Field Trip: Smithsonian Air & Space Museum Annex at Dulles Airport -
Stephen F. Udvar-Hazy Center. *NEW! AMAZING!*
Family fun: Smithsonian Museums - FREE! Easy access to shopping at Crystal Underground.
Short ride to Old Town Alexandria and Mt. Vernon.

HOTEL:

Crowne Plaza National Airport - A first class, full service hotel in Crystal City, Arlington, VA.
Our rate: \$89/day + tax. Parking: \$11/day. Reservations: 1-703-416-1600.
Ask for AMSAT/ARISS Special Rates.

REGISTRATION - TRANSPORTATION - TOURIST INFORMATION:

See: <http://www.amsat.org> or TOLL FREE: 1-888-FB-AMSAT FAX: +1-301-608-3410
Call Martha! TEL: +1-301-589-6062 E-MAIL: martha@amsat.org

EVERYONE WELCOME !

SEE YOU THERE !



From Echo to OSCAR 51

by Lee McLamb, KU4OS, KU4OS@amsat.org



Introduction

Have you ever dreamed of being a part of the space program? Perhaps you've dreamed of building and operating an Amateur Radio station in space? At AMSAT¹ those dreams have been becoming realities since inspired by the launch of the first Orbital Satellite Carrying Amateur Radio (OSCAR-1) in 1961. AMSAT's latest project, known as Echo, has now been officially designated as AMSAT OSCAR 51 (AO-51) is continuing that proud tradition. In this article we'll follow Echo on its final journey from Virginia in the United States through its final checkout and launch in Baikonur, Kazakhstan and discuss what capabilities AO-51 has to offer.

The Echo project was conceived with the goal of launching a highly capable voice and digital satellite into low Earth orbit (LEO). Echo is a 9.5 inch cube and is known as a microsat. The satellite's structure is made up of a set of six stacked aluminum trays that hold the various modules. Figure 1 shows a block diagram of the satellite and also provides a layout of what is in each tray.

On June 9, 2004 Echo was placed in the vacuum chamber at the SpaceQuest² facility in Virginia for an hour and pushed hard with both 70 cm transmitters running full power.

Before packing Echo for shipping a final check of the sensitivity of all the 2 m receivers and the wide band tunable receiver (SQRX) was made as well as characterizing the received signal strength indicator (RSSI).

Travel to the Launch Site

With the final checks complete, Echo was loaded into its shipping container and Chuck Green, N0ADI, representing AMSAT, along with a team from SpaceQuest who are also

all hams, AMSAT volunteers and were escorting another group of satellites, headed out for New York's JFK airport. Chuck provided the following account of his trip with Echo.

"When you plan to fly and your hand-carried item happens to be a satellite, it pays to plan ahead. Airport Security had been notified in advance that we would be bringing the three satellites. As a backup the team also had the names and phone numbers of several levels of security management ready. The preparation paid off. Since they were expecting us, there was no problem. Security took one of the satellites and opened the box. They just poked around a bit and we were on our way to the Aeroflot gate for the flight to Moscow.

Once on board the aircraft, a B-777, the satellites were quickly stowed in the overhead bins. There was a bit of a buzz among the passengers about the very suspicious characters with those three white boxes. Most people seemed to believe we were carrying donor organs. By the time the team arrived in Moscow it was June 10 and

after clearing customs, we then took the hotel shuttle bus and checked into the Novotel hotel.

June 11 began early at 4:40 AM with a drive to the other side of Moscow to another airport where our flight to Baikonur would depart. At the airport we also met the teams supporting the satellites from Italy and Saudi Arabia. The flight to Baikonur was on a Russian TU154. After clearing customs with the Kazakhs and passport control with the Russians, we then got onto a bus to take us to the Sputnik Hotel.

June 12 was a Saturday. More important, it was Russian Independence Day and a holiday. There would be no chance to work on preparing Echo for launch that day. That would have to wait until Sunday. A tour of the city had been arranged with the bus leaving at 10 AM. Our guide was, Boris, an ex-military officer, who spent 16 years here in Baikonur. He loves this city, is very proud of the accomplishments achieved here, and very much enjoyed telling us all about it through an interpreter, Anna. The city is full of monuments. We were taken to a small

observation structure overlooking the river where the decision was made who the first man to go into space would be. This clearly is a place of great meaning to those who were a part of this place.

Launch Preparations

June 13 is the first day working on Echo to get it ready for launch. It is about 25 miles (40 km) from the hotel to the integration facility. The bus took almost 1.5 hours to get there today. We went slowly today because we were carrying lots of satellites. Each day the teams will go to the integration facility and return to the hotel on the bus so we must manage our work to match the bus schedule. The bus leaves

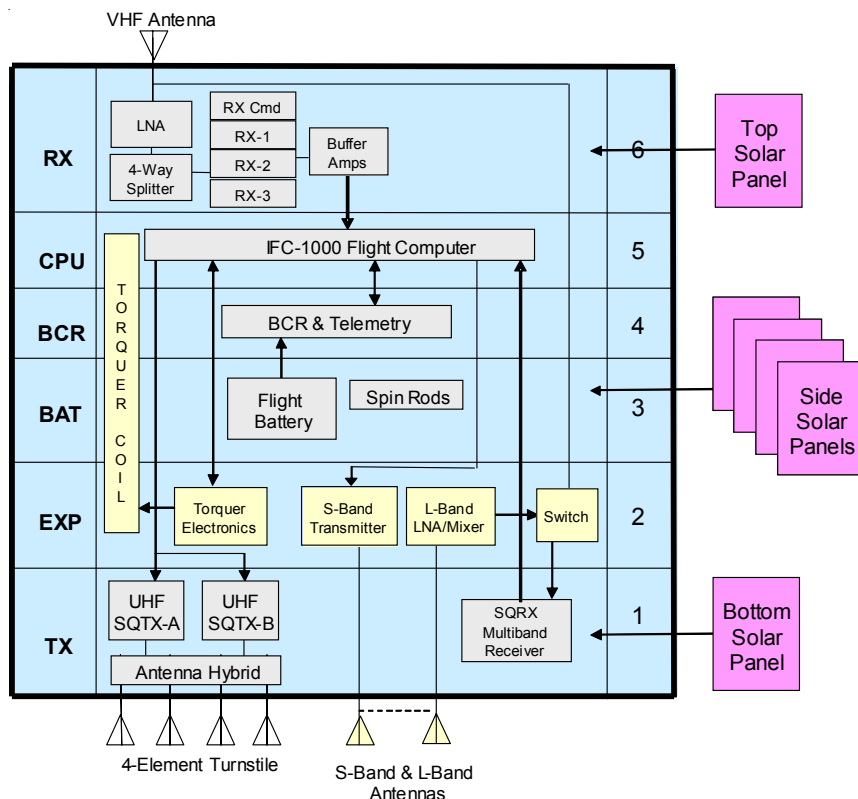


Figure 1
Echo/AO-51 Block Diagram



the hotel at 8 AM and returns about 7 PM. Most days the trip will take about one hour each way.

Once the team arrived at the launch integration site they were then given a safety briefing. During the briefing the shipping containers were cleaned and placed in the clean room. With the team dressed in clean room garb and in the clean room, Echo was taken out of its shipping case and set up on our table. Then the bottom antennas were installed along with the bottom solar panel, magnet and corner reflectors." Chuck said, "Then we turned Echo on and successfully communicated with it over the umbilical from my computer." He continued, "We then went through most of the test procedure and everything looks good so far." The four 2m receivers and the two 70cm transmitters were successfully tested.

"The following day we finished preparing Echo. All the solar panels were installed as well as the antennas. This is a slow process. Loctite® is required on each screw and there are a lot of screws holding the solar panels. Each solar panel was plugged into the satellite and the connector secured as it is placed against the body of the satellite. The antennas were then installed and secured with adhesive at their connectors. Finally we also did a fit check by placing it on the base it will fly on to make sure everything is adjusted properly." In Figure 2 you can see Chuck standing behind the assembled Echo satellite.

"June 15 will be our last day working on the satellite before launch. It's time to weigh Echo. We put it on a double-balance scale



Figure 2
Chuck Green, N0ADI, with Echo in Baikonur, Kazakhstan.

The Echo Launch Campaign

by Chuck Green, N0ADI, n0adi@amsat.org

It started for me on June 1 by heading from Tucson, AZ to Parker, CO to spend a couple of days with Jim White. There I made a few changes to Echo's wiring harness, etc. that Jim had been saving for me. He also gave me a test procedure to be performed in Virginia and then in Baikonur, Kazakhstan. He also gave me Echo, which I took as a carry-on item from Denver, Co to Washington.

Echo and I arrived at SpaceQuest in Fairfax, VA in good shape. I spent the next few days cleaning and preparing each of Echo's module trays for flight. I also did the wiring of the solar panels and a few other items. Echo was then reassembled and tested. The SpaceQuest team was very helpful with much of this activity. But they were very busy preparing two of their own satellites for this same launch. Echo was put back in its shipping container and we were ready to travel to Baikonur. Four SpaceQuest people and I would be traveling together with three satellites.

Getting to Baikonur involved driving from Virginia to New York's JFK airport. From there we flew to Moscow where we spent one night. We were then driven to a smaller airport on the other side of Moscow where we boarded a flight to Baikonur.

The flight to Baikonur took about three hours. We arrived there safely and were taken to our hotel. The next day was Russian Independence Day so we had a day of R&R. Then we were loaded into a bus with the other teams and their satellites and taken to the integration facility.

The integration facility is about 50 km from Baikonur. We are only allowed to leave Baikonur when we have a "security" escort and we are not allowed to take pictures outside the city except at the integration facility. The bus driver went very slowly this day because the satellites were on board and the road is not particularly smooth.

At the integration facility we were given an office and a space in the cleanroom to prepare Echo and the two SpaceQuest satellites. With all the satellites planned to be on this launch the cleanroom was a bit crowded, but it was adequate. We prepared Echo for launch by installing the solar panels, antennas, etc. We then ran the tests provided by Jim and Echo was ready for integration onto the launch platform.

Echo weighed in at 11.14 kg and passed its fit check without difficulty. It was then installed on its mounting base and clamped down with the pyro clamps that would release it at the appropriate moment. The base was then installed on the satellite platform along with the other satellites. A protective shroud was placed over the satellites. That was our last glimpse of Echo.

The next day the SpaceQuest team went home. I remained until the launch to satisfy State Department requirements. I had more than a week with nothing to do while the satellite package was placed on the rocket and the rocket fueled for launch. I received periodic updates on the progress but was not in any way involved. All went as planned.

On launch day we were taken on busses to an observation point. I was on the telephone with Mark Kanawati back in Virginia at the time of the launch so I was able to give him the exact time it occurred. After a little over 900 seconds we received word that all satellites separated successfully and were in their intended orbits. I called Mark back to give him the good news. Echo was in orbit!

Later that same day I flew back to Moscow. I was in Moscow two nights because of flight scheduling requirements and then flew directly to Los Angeles where I changed planes and flew back to Tucson on July 1.

It was a very busy and unforgettable month and a day. The final preparation of Echo had gone well. The integration activity in Baikonur was conducted in a professional manner by the launch provider and the launch was a success. Plus, I had a little over a week to spend with some of the local people there in Baikonur, which I will always remember.

Now the fun begins ... let's use Echo!



and it weighed in at 24.56 pounds (11.14 kg). Echo was then placed on the "dispenser" plate. This is a slab of aluminum about 20 inches (1/2 meter) square and an inch (2-3 cm) thick. Echo shared this plate with the Italian satellite. The carrying handles were removed for the final time and then the dispenser plate was placed on the platform from which all the satellites are deployed. We are ready to fly! Things will be very quiet from now until launch day.

June 29, today is launch day. It started with a Kosmotras supplied breakfast at 8 AM. Then there was a formal readiness report regarding the rocket. All the high level people were there including the director general and a general grade officer in charge of the military forces that would launch the rocket as a practice exercise. Someone representing each satellite was asked to state the readiness of their satellite. Then the general declared that there was no reason not to proceed with the launch.

The Launch!

A little while later we all got on the buses and headed out to the viewing site. It wasn't very long before the launch occurred. First there was a huge eruption of smoke as the rocket is pushed rapidly up out of the silo. After going mostly straight up for a few seconds it began to head south and back over us. Soon we could hear the roar of the engines. Because it quickly went back over our viewing angle under our shelter, everyone ran out behind the shelter so they could continue to see it. We could see the first stage separate and the second stage take over.

I stood near the interpreter. Every ten seconds there was a report. It was a bit repetitive, but also reassuring that everything was going well. The second stage shut down and the third stage took over. After 900 and something seconds the satellites began to be separated. One at a time in rapid succession the names were called out. All satellites were separated successfully.

There were a lot of cheers and hugs and about every other kind of emotion you could think of. I ran back inside the shelter before anyone else could think of it and called to report the successful separation of our satellite.

Then we got back on the buses and took the short ride over to the launch site. The huge defensive door over the silo was standing

open and smoke was still coming up out of the silo. They had put up a protective rail around the pit so no one would fall in. Looking inside was dark and threatening. Everything was soot black.

We all got back on the buses to return to our hotel. On the way back the Italians received an SMS message saying that their satellite had been heard on the first orbit. Their satellite had only been four degrees above the horizon but that was enough to hear it. The bus erupted in celebration.

There was then a press conference followed by a reception. After the reception we had about a half hour to pack and get back on the buses to be taken to the airport for the long trip home."

Echo is in Orbit!

About ten hours after launch the command team in the US commanded Echo's transmitter on and began the process of checking out the satellite in orbit. With the preliminary checks complete Echo was then designated AMSAT OSCAR 51!

Echo Overview

Echo, now known as AO-51, is expected to be able to support multiple users and modes simultaneously. The two primary modes of operation will be as an FM analog voice and 9600-baud packet. The FM analog voice mode will operate in a manner similar to SO-50. The big difference will be in the received signal strength on the ground. While SO-50 operates at 250mW, AO-51's transmitters have a variable power output and can operate at as high as 8w output on 70cm. The exact transmitter output settings are still being determined and will be based on the

2m/70cm FM rig, you may find that you already have a satellite ground station just waiting to be used.

The second primary mode will be 9600-baud packet using the PACSAT protocol pioneered on AO-16 and still in use on UO-22 and GO-32. AO-51 will be essentially an orbiting file server available for uploading and downloading of messages and files. Many stations have already reported success copying the 9600-baud downlink data using radios like the Kenwood TM-D700 as well as hardware TNCs and sound card packet software such as MixW³ and AGWPE⁴.

AO-51 also carries a tunable wide band receiver and S-band transmitter. These will be used for experiments such as high-speed data links or perhaps even a PSK-31 transponder where many stations could chat keyboard-to-keyboard at the same time. AO-51 is truly a very flexible satellite. Receivers and transmitters can be switched around in almost any combination and mode. Table 1 lists the planned frequencies for initial operation. The current status of AO-51 and all the Amateur Radio satellites can be found on AMSAT's Web site. Also available from AMSAT is the AMSAT News Service that provides email bulletins about on going satellite activities. Instructions for subscribing can also be found on the Web site.

Acknowledgements

Many people contributed a great deal and deserve special thanks for helping Echo become AO-51 including:

Jim White, WD0E, for his technical contributions, leadership skills and for the many hundreds of hours he has invested.

Mike Kingery, KE4AZN, for on-site support of integration testing, including the loan of his satellite station and for developing command and telemetry ground station software.

The SpaceQuest team, especially **Mark Kanawati, N4TPY**, **Dr. Dino Lorenzini, KC4YMG**, and **Lyle Johnson, KK7P**, who are also AMSAT members and volunteers.

Harold Price, NK6K, for his donation of the Spacecraft Operating System (SCOS) kernel and file system and for his on-site integration support.

Bob Diersing, N5AHD, for his timely work

Mode	Uplink to Echo	Downlink from Echo
FM Voice	145.920 MHz with 67 Hz PL Tone	435.225 MHz
9600-Baud Packet	145.860 MHz	435.150 MHz
L/S	1268.700 MHz	2401.200 MHz

Table 1
Echo Operating Frequencies

amount of power available from the solar panels. During the first week of checkout the panels have been averaging about 16W of power with a peak output of 20W. This is expected to provide excellent reception for very modest stations. If you have a dual band



on the boot loader.

Skip Hansen, WB6YMH, for his efforts on the ground station software.

Chuck Schultz, KE4NNF, Harold Sanderson, KT4XK, Lou McFadin, W5DID, and Stan Wood, WA4NFY, for their work on the S-band transmitter and L/S band antenna system.

The AMSAT project management team for their help and assistance, especially **Rick Hambly, W2GPS**, and **Dick Daniels, W4PUJ**.

David Bern, W2LNX, for his assistance with the ground station hardware.

Chuck Green, N0ADI, for his work at the launch site and providing a great deal of material for this article.

You too can help support AO-51 as well as other existing and future Amateur Radio satellites by joining AMSAT. Applications are available on the Web or you can simply call the AMSAT office at (888) 322-6728.

References:

1. AMSAT
850 Sligo Ave., Suite 600
Silver Spring, MD 20910
<http://www.amsat.org>
2. SpaceQuest Ltd.
3554 Chain Bridge Road, Suite 103
Fairfax, VA 22030
<http://www.spacequest.com/>
3. MixW
<http://www.mixw.net/>
4. AGWPE
<http://www.raag.org/sv2agw/agwpe.htm>



Echo Officially Named AO-51

AMSAT-NA President Robin Haighton, VE3FRH, has asked me to handle issuance of OSCAR numbers and has written me requesting an OSCAR number for the Echo satellite. Therefore, in response to his communication, I hereby issue Echo the number AMSAT-OSCAR-51 (AO-51) to this exciting new Amateur Radio spacecraft. Thus, AO-51 joins a long line of Amateur Radio satellites beginning with OSCAR-1 launched in December, 1961.

I wish to congratulate everyone involved in the design, construction, testing, preparing for launch, launching and commissioning of this latest Amateur Radio spacecraft.

I trust that amateurs all over the world will have an opportunity to avail themselves of the many features offered by AO-51. May AO-51 have a long and productive life.

Best wishes and 73,
William (Bill) Tynan, W3XO 🌐

The N3SH operation near Pittsburgh, PA had a successful Field Day and operated through several satellites. Jim, WB4GCS, provides the following description:

I can't describe how much FUN we had. This was the best FD I've had in 10 years and they've all been good. This club has been trying for 2 years to make a satellite contact during FD so, for our first one, there was quite the crowd and they were EXCITED. Also of interest, several of the post-FD messages on the AMSAT-bb related to working us. Guess we made a difference for a few people. I think we generated a new member or two for AMSAT.

73,

Jim, WB4GCS

Equipment: IC-910, and when we realized AO-7 was in mode A, we pressed an FT-817 into service on 10m. I provided the 910 and Kevin, N3HKQ, provided the 817.

Antennas: M-squared 22 el 70cm and homebrew (by WB4GCS) K1FO 2 x 11 element on 2m. (I scaled the design up from weak signal band.) They were atop 30 feet of Rohn 25. Rotor: Yaesu G5400.

Computer: Toshiba laptop running Nova, manual tracking. (Got the auto tracking working AFTER FD!)

People in the group photo: I'm the guy in middle with the black hat, behind me is Hank, KB3FNM and his XYL, Mary Lou. To my left, Carol, KB3GMN, is trying to work 10m, but having difficulty due to all the noise we're making. I do not know the name/call of others in the photo, but all are members of WASH (Wireless Association of South Hills). Birds: We worked FO-29, AO-7 and used UO-22 to prove things were working. We tried the FM birds, but you know that story. 🌐



Quickie S-Band Antenna Three Hours or Forget It!

Gunther Meisse, W8GSM

Don't ever let it be said that S-Band is just too complicated to be of any interest for satellite use.

The other evening I was confronted with a challenge when my son was unable to get a good signal from what, in our family, we call our "Bambi Cams". In our normal applications, we use them to watch the deer feed at our deer feeding stations. Very often it is the best show on TV!

They are the small, three inch square, 2Ghz transmitters modulated with full NTSC video & audio, used by the model helicopter and airplane hobbyists. They transmit a few milliwatts and use a slick little patch antenna. The matching receivers likewise use the same small patch antenna. Fine for a couple hundred yards, but this combination will not make it for substantial distances.

In this case, distance was the issue. My son told me of his problem and said he needed a fix by the following midday. That evening, just before jumping in bed, I told him that "in the morning" I would fix his problem. Just prior to turning in, I noticed that, after a rebuild to XP on my computer, I no longer had the nice little program to create the size specs for building my "secret weapon". I put out a plea on the AMSAT -bb and called it a night.

In the morning, fresh from my night of subliminal thinking, uncluttered with all those "sensor interrupts" to service, and a mental database full of AO-40 experience, I was ready for action. What to my wondering eyes appeared, but a number of great e-mail responses, complete with a list of Web sites with the helix calculators. Now, the next issue was to get the finished product to him in three hours, so we had to: think "fast", think "simple" and think "in stock". With dimensions in hand, it was back to the workbench.

First we needed a reflector. What better than a nice 6" square of unused PCB? Next, we needed a structure for the helix that was to be 1.97" in diameter. Hmmmmmmm.. Look there - a plastic tube that had contained a wall poster. A quick check produced a tube within one tenth of an inch of target. Fortunately, the helix is a very tolerant antenna and 1/10th of an inch is not an issue. Next, after cutting the plastic tube to the desired 18" length and a quick microwave

oven test to be sure this "find" did not absorb microwaves, I placed a magic marker dot along the length of the tube marking the location of each turn.



Photo 1
A view of the finished S-band helix antenna.



Photo 2
Details of the feed.

Now, we had to use a simple and fast way to create a radiator on this plastic tube.. A roll of 1/4" sticky backed copper tape was in the box, just where it was supposed to be. (What are the odds of that?) The sticky backed tape was ideal since it provided a quick way to fasten to the plastic tube. So, holding the roll of tape in one hand, the plastic tube in the other, I gently rolled the tape around the tube at precisely 12.5 degrees. Well, since one can see through the tube, and see the

next dot coming, it has to be close. Having used this 1/4" copper tape before, I recalled that it does not perform well when the wave-front hits the 1.5 mil edge rather than the 1/4" face. Remember those writings about the diameter of the radiator significantly affecting the result? So, with a razor blade I removed the insulation from a piece of #14 copper wire, removed any kinks, and started to wrap it on the tube, on top of the tape, soldering it every one-half turn.

With the tube completed, it was time to mount it to the PCB reflector. A job that called for quick-set epoxy. A nice generous application to the PCB, a steady hand holding the tube for a minute or so, drill a small hole for the coax, solder the shield to the PCB, the center conductor to the #14 wire, and "Voila", an S-band 15 turn Helix with about 15 dBi gain. The bottom (nearest the reflector) of the wire was formed to run parallel to the reflector to create the impedance reduction from the inherent 140 ohms to a more acceptable value. Since the application was to receive only, I did not use a bridge to tune. Receivers are much more tolerant of a less than ideal SWR, and I had

only one hour left for the epoxy to dry if I was to meet my guarantee.

One hour later I proudly presented my "**Quickie S-Band Helix**" to my son, and most important, it worked.

The moral of the story is simple. "Simple" is possible and "simple" works on the microwave bands. You don't have to be a brain surgeon to join the microwave fan club. An interesting footnote: Two of my sons were so favorably impressed with the knowledge that one can pick up within ham radio, they both will be taking their ham test next month so they can get in on the fun. (You just never know what will do the trick! I have tried to get them interested for years.)



The
AMSAT[®]
Journal



Field Day 2004 Results

by Bruce Paige, KK5DO, kk5do@amsat.org
Vice President of User Services

This year a total of 7 logs were submitted, way down from the 37 logs in 2003. All were operating on Emergency Power. Five of the entries were stateside and one entry was from Mexico. The low number of submissions was due to the loss of UO-14 and AO-40. However those participating were able to make contacts both by voice and packet with the ISS and most of the contacts were on FO-29 with AO-7 close behind.

Here is a break down of the 51 total reported QSO's:

FO-29 CW-7 SSB-21
AO-27 FM-14
AO-7 CW-1 SSB-19
SO-50 FM-4
ISS Packet-1, Voice 5 (Including QSO's made by the NA1SS)

This year with very low participation, the winner is NX2Q with 37 points followed by W5ACM with 16 points and XE2AT with 8 points taking 3rd place. All were running Emergency Power this year so there were no Commercial Power entries. Here are the rankings with their point totals:

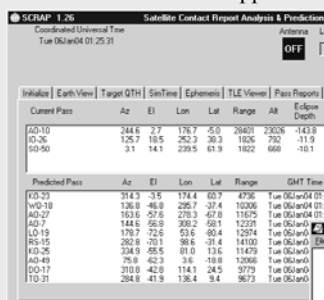
Emergency Power Entries			
Rank	Group	Class	Score
1	NX2Q	1A	37
2	W5ACM	2A	16
3	XE2AT	1E	8
4	K9IQP	2F	6
5	N4XEO	2A	5
6	KA3PCX	1E	4
7	N4TP	2A	1



The winning NX2Q team is shown here with their antennas in the background. From left to right are Jeff, KT2K, his harmonic Jeffrey, SWL, and Al, NX2Q.

Satellite Contact Report Analysis Prediction

AMSAT is now the North American distributor of SCRAP, a satellite tracking program designed specifically for ham satellite applications



Functional Features

1. Initialization
2. Earth View
3. Target QTH
4. Date/Time Simulation
5. Ephemeris
6. TLE Viewer
7. Pass Reports
8. APRS display
9. Multi-Track display
10. Antenna rotor control
11. Astronomical prediction

Recommended minimum processor

1. Windows 98 or better
2. Pentium Processor 500 MHz or greater
3. 256 MB RAM
4. Graphics accelerator card desired
5. 1024 x 767 resolution recommended

SCRAP is a product of the
Bytheway Software Development Lab (BSDL)
 More info at <http://www.rtty.com/bytheway>

Performance Features

1. Contact Prediction / Reports
2. SGP/SDP ephemeris prediction
3. Real-time 3-D visualization
 - a. City, country, satellite labels
 - b. Lakes, rivers, islands
 - c. National boundaries
4. Over 25 Earth texture overlays
5. APRS station display
6. Multiple ground station support
7. Antenna rotor Az/EI control
8. Internet updates
 - a. Two line orbital elements
 - b. APRS station locations
9. Astronomical data (Planets, moon)
10. Simulation

Order your copy now

Price is \$50 for AMSAT members, \$60 for non-members, postpaid on CD-ROM. Order by calling 1-888-322-6728, or use the online shop at <http://www.amsat.org>



AMATEUR RADIO ON THE INTERNATIONAL SPACE STATION - PHASE 2 HARDWARE SYSTEM

Frank H. Bauer, KA3HDO, Sergej Samburov, RV3DR, Lou McFadin, W5DID, Bob Bruninga, WB4APR and Hiroto Watarikawa, JJ1LYU

INTRODUCTION

The International Space Station (ISS) ham radio system has been on-orbit for over 3 years. Since its first use in November 2000, the first seven expedition crews and three Soyuz taxi crews have utilized the Amateur Radio station in the Functional Cargo Block (also referred to as the FGB or Zarya module) to talk to thousands of students in schools, to their families on Earth and to Amateur Radio operators around the world.

Early on, the Amateur Radio on the International Space Station (ARISS) international team devised a multi-phased hardware development approach for the ISS ham radio station. Three internal development Phases - Initial Phase 1, Mobile Radio Phase 2 and Permanently Mounted Phase 3 plus an externally mounted system, were proposed and agreed to by the ARISS team.

The Phase 1 system hardware development, which was started in 1996, has since been delivered to ISS. It is currently operational on 2 meters. The 70 cm system is expected to be installed and operated later this year.

Since 2001, the ARISS international team has worked to bring the second-generation ham system, called Phase 2, to flight qualification status. At this time, major portions of the Phase 2 hardware system have been delivered to ISS and will soon be installed and checked out.

This paper intends to provide an overview of the Phase 1 system for background and then describe the capabilities of the Phase 2 radio system. It will also describe the current plans to finalize the Phase 1 and Phase 2 testing in Russia and outlines the plans to bring the Phase 2 hardware system to full operation.

HAM RADIO EQUIPMENT SPECIFICS

Ham Station Location

The ISS ham radio equipment will reside in two locations inside the ISS and at least one location outside the ISS. Two-meter (144 MHz) operations will primarily be conducted inside the Functional Cargo Block (FGB), named Zarya, using antennas that supported docking of the FGB with the Russian Service Module. These antennas, designed for use near the 2 meter band, (see Figure 1) no longer support docking and can

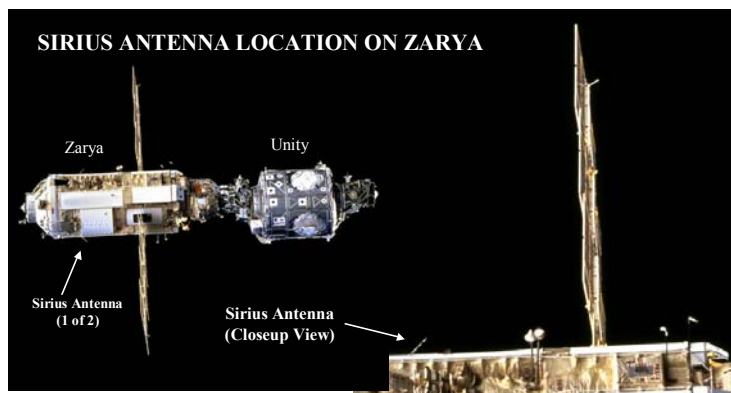


Figure 1
FGB 2-meter Antenna Locations

be used by the ARISS team permanently. This is the current location of the 2 meter portion of the Phase 1 ISS ham radio station. The FGB radio system represents a minimal capability that allows the ARISS team to support school group contacts and packet communications on one band, the 2 meter band.

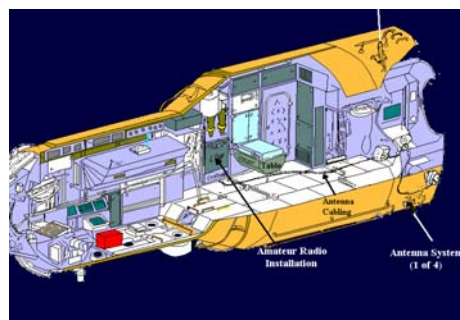


Figure 2
ARISS Hardware in Service Module

The ARISS team's vision of supporting several different international users at the same time on separate frequency bands and different modes (voice, data, television, etc.) requires several different antenna systems. The ARISS-Russia team, led by Sergej Samburov, RV3DR, provided this foundation through the installation of four ham radio antenna feedthrough ports on the Russian Service Module. With these antennas in place, the primary location of the ham station will reside inside the Russian Service Module (SM) named Zvezda. The ham station will be installed near the SM dining table. See Figure 2. Simultaneous multi-band operations can be conducted with these two (SM and FGB) station locations.

The ARISS team is also working with the international space agencies to install externally mounted Amateur Radio equipment on the ISS. This hardware will enable the crew to communicate with Earth-

bound radio amateurs and school students using handheld systems that can be moved throughout the ISS. It will also support communications experimentation that will enable students and radio amateurs to receive telemetry data from ISS.

Phase 1 Hardware Overview

The ARISS team has developed all the hardware elements for the Phase 1 radio system. These hardware elements have been flown to ISS on three Shuttle flights. The Phase 1 system

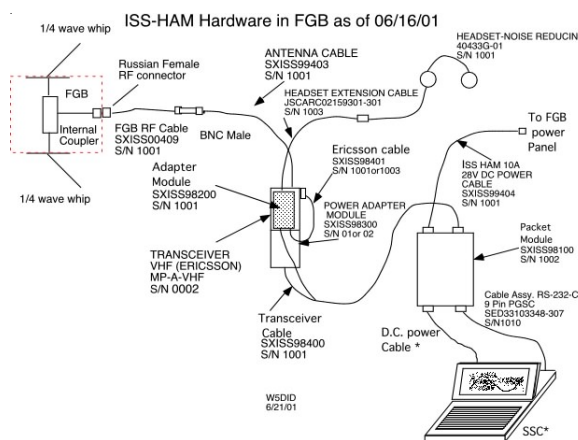


Figure 3
ISS Ham Phase 1 System in the FGB



Figure 4
Ericsson Radio



Figure 5
Phase 1 Hardware



Figure 6
Phase 1 Packet Module

supports voice and packet (computer-to-computer radio link) capabilities. Packet radio has several capabilities including an APRS Instant Messaging-type system and a Bulletin Board System that allows radio amateurs to store and forward messages and allows the orbiting crew to send e-mail to all hams or to individuals.

The Phase 1 ham radio system was developed primarily in the US. However, extensive testing and coordination with the ARISS-Russia team was required since it is installed in the ISS Russian segment. The

initial portion of the Phase 1 ISS ham radio system was launched on-board the STS-106 Space Shuttle Atlantis mission on September 8, 2000. This system consists of two hand-held Ericsson MP-A transceivers for 2 meters and 70 cm, a power adapter, an adapter module, an antenna system, a packet module, a headset assembly, and the required cable assemblies (see Figures 3, 4 and 5). This configuration can be operated in the attended mode for voice communications and either the attended or automatic mode for packet communications.

Additional ARISS Phase 1 hardware was deployed during two additional Shuttle flights to ISS. This hardware included an additional Packet Module on the STS-105 Discovery flight on August 10, 2001 (see Figure 6), and additional cables and modules

to support simultaneous 2 meter and 70 cm operation on the STS-108 Endeavour flight on December 5, 2001. Details of the Phase 1 system are described in reference 1.

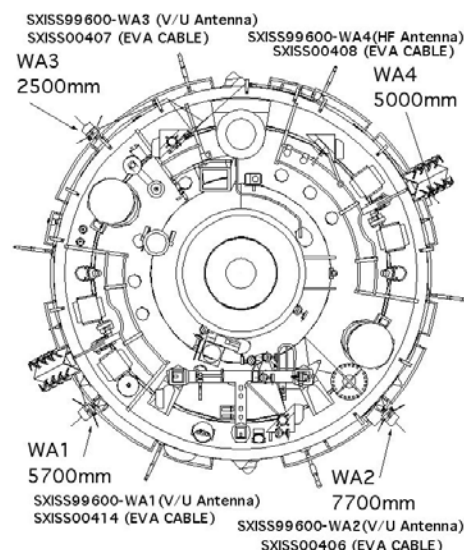


Figure 7
Antenna Location from End of Service Module

Antenna Assemblies

In 2002, a set of four antenna systems, developed by the ARISS team, was deployed during three Russian EVAs. These antennas will support the Phase 1 and Phase 2 systems in the Service Module. Once checked out,



Figure 8
Antenna Systems WA1 - WA4

the specially designed antenna assemblies will permit operations on HF (20 meters, 15 meters and 10 meters), VHF (2-meters), UHF (70cm), and the microwave bands (L and S band). These antennas also permit the reception of the Russian Glisser EVA video signals (2.0 GHz). This dual-use (ham/EVA video) capability is the primary reason the ARISS team received access to the four antenna feedthroughs located on the outside of the Service Module.

A total of four antenna systems were developed to get maximum use of the antenna feedthroughs. These were installed around the periphery of the far end of the Service Module. See Figure 7. Three of the antennas (WA1-WA3) include a VHF/UHF flexible tape antennas. WA4 includes a 2.5-meter flexible tape HF antenna. The U.S., Italian and Russian ARISS partners developed the antenna systems.

Each antenna assembly consists of a mounting plate, spacer, a black striped handle, a Russian handrail clamp, an orange-colored VHF/UHF (or HF) metal flexible tape antenna with black delrin mounting collar, an L/S band flat spiral antenna with a white delrin radome cover, a diplexer (mounted underneath the plate) and interconnecting RF cables. See Figure 8.

The antenna systems were launched on the Space Shuttle Endeavour flight on December 5, 2001. The two up-looking (zenith) antennas, WA3 and WA4, were deployed by EVA (space walk) in January 2002 and the two down-looking (Nadir) antennas, WA1 and WA2, were deployed by EVA in August 2002. Antenna installation EVA procedure development and training was led by Sergej Samburov from Energia with support from the ARISS-USA team.

PHASE-2 HARDWARE SYSTEM Phase 2 Hardware Overview

The Phase 2 hardware system is expected to exploit the new antenna systems installed on the Service Module. Two new radio systems will be installed as part of Phase 2. These systems will augment the two Ericsson radio systems already on-board the ISS as part of the Phase 1 system. Combined, the Phase 1 and Phase 2 system will provide more capabilities for the crew and permit simultaneous, multi-mode operations by more than one crewmember.

The Phase 2 development is a joint Russian, U.S. and Japanese activity. Development was led by Russian team member Sergej Samburov, RV3DR. The Russian team was responsible for certifying the hardware for flight and providing the ride on the Progress launch vehicle. The Japanese team provided (donated) the Kenwood radios to the ARISS team and made specific hardware and firmware modifications to the radio system to prepare it for flight. The USA team, in conjunction with the Japanese and Russian team, developed the Program Memory software that provides a powerful system with a very user-friendly interface for crew.

One of the two radios qualified for flight is a Kenwood TM-D700 radio. This radio supports 2 meter (144-146 MHz) and 70 cm



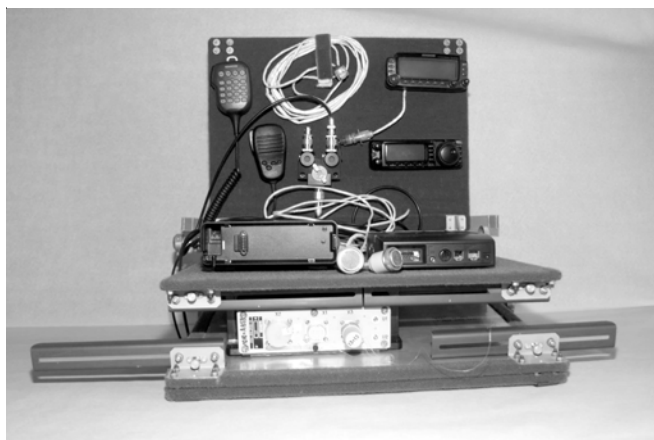


Figure 9
Phase 2 Hardware Housed in Velcro Table
(435-438 MHz) transmit/receive operation and L-band uplink operation. This radio provides a higher output power capability (10-25 watts) than the Phase 1 radio system and can support FM and packet operations. The higher power capability should allow nearly horizon-to-horizon signal reception using simple hand-held radios or scanners.

The other radio is a Yaesu FT-100. This radio system will permit operation in the high frequency bands. Of particular interest is performing ionospheric propagation experimentation using the WA4 (high frequency) antenna and this radio. This radio also supports higher output power capabilities on 2 meters and 70 cm.

The entire set of Phase 2 hardware consists of the Kenwood and Yaesu radios, an RF tuning unit for the Yaesu radio system, interconnecting signal and RF cables, two specially developed Energia power supplies, a power distribution assembly developed by the USA team, a computer and the 70 cm Phase 1 hardware system. These will be mounted on a Velcro-backed table. See Figure 9. These radio systems will be connected to the four Service Module antenna systems through a Russian developed antenna switching system. See

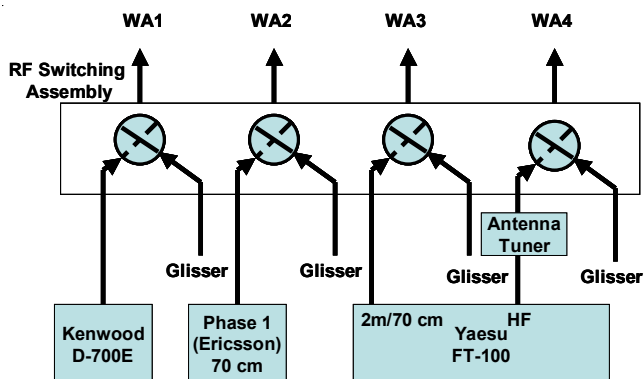


Figure 10
RF Layout of ISS Ham Radio Systems

Figure 10. A schematic of the hardware configuration is shown in Figure 11.

Kenwood D-700
Specifications

The ARISS and Kenwood teams agreed that the Kenwood European model radio, D-700E, would be used for flight and ground operations. This radio was already certified by the Russian team.

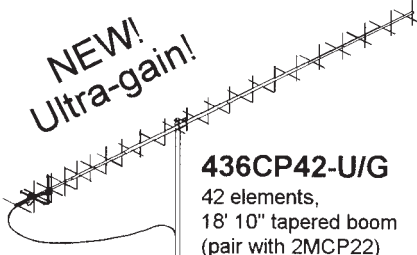
Several modifications were made by the Kenwood Japan and Kenwood Moscow (Bermos) teams to prepare this radio system for flight. These included:

- 1) Developing a special Memory Control Program (MCP) to support reprogramming of the radio in the USA, Japan and Russia to ARISS specifications.
- 2) Changing the packet radio default parameters, as specified by the ARISS team, in EEPROM memory.
- 3) Enhancing the "repeater mode" of the radio system.
- 4) Replacing the power cable and the microphone and control head cables with flight cables to allow certification of the hardware to the Russian requirements.
- 5) Reducing the maximum power output of the radio to 25 watts.
- 6) Replacement of the 6-pin data connector with an 8-pin connector. One of the additional pins on this connector supports an 8 V DC output capability.
- 7) Incorporating a channel designator for the front panel as the default instead of the frequency information.

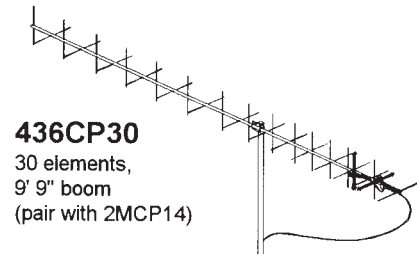
The architecture of the radio interface to the crew was carefully crafted by the USA and Japanese team to make the D-700 a powerful radio system with a simple user interface. A set of 5 default options, or Programmable Memories, were embedded in the D700 to support ISS operations. See Figure 12. The advantage of these five Program Memories (PM's) are that they can be restored with a two-button key press by the crew at any time. With the two hundred different

M² YOUR SATELLITE ANTENNA SOURCE

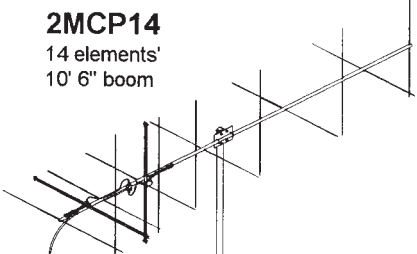
NEW!
Ultra-gain!



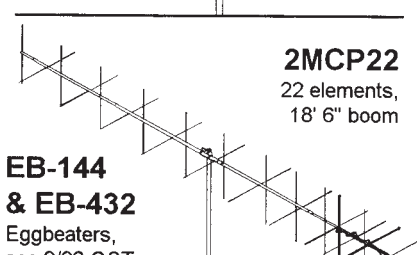
436CP42-U/G
42 elements,
18' 10" tapered boom
(pair with 2MCP22)



436CP30
30 elements,
9' 9" boom
(pair with 2MCP14)

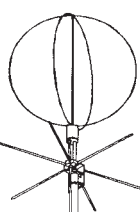


2MCP14
14 elements'
10' 6" boom



2MCP22
22 elements,
18' 6" boom

**EB-144
& EB-432**
Eggbeaters,
see 9/93 QST



- Stacking frames
- AZ & EL positioners
- Fiberglass crossbooms
- Power Dividers
- Phasing harnesses

M² 4402 N. Selland
Fresno, CA 93722
(559) 432-8873 FAX: 432-3059







AMSAT is the North American distributor of **SatPC32**, a tracking program designed for ham satellite applications. For Windows 95, 98, NT, ME, 2000, XP.

Version 12.2 now supports Labjack U12 and W0LMD rotor controllers and Doppler tuning for Yaesu FT-817/857/897.

Features:

- Graphical tracking on a world map with two selectable Zoom factors.
- One-click satellite switching using 12 “letter” buttons.
- Automatic rotor control support for: Kansas City Tracker/Tuner, FODtrack, Uni_Trac, SatEL, Labjack U12/Piggyback, W0LMD Mini/Junior/Senior Trackers, Yaesu GS-232, ARS from EA4TX, EGIS rotors, IF-100, RIF-PC, AMSAT-DL interface, WinRotor32, HalloRotor, and WiSP DDE clients.
- Doppler tuning with on-screen frequency displays. Radio models supported: Yaesu FT-847, FT-736R, FT-817, FT-857, FT-897 ICOM IC-820H, IC-821H, IC-910H and other ICOM radios Kenwood TS-790 and TS-2000 DDE client programs
- “Transparent” VFO-knob tuning in addition to keyboard and mouse tuning.
- “Virtual” VFO tracking for half-duplex transceivers FT-817, FT-857, FT-897.
- Includes a special version for ISS split-frequency operation.
- Controls subaudible tone on FT-847, FT-736R, FT-817/857/897, and IC-910H.
- Includes a non-graphical version and programs that output lists to the screen, printer, or a file.
- Interfaces with WiSP, with user-defined satellite switching priority.

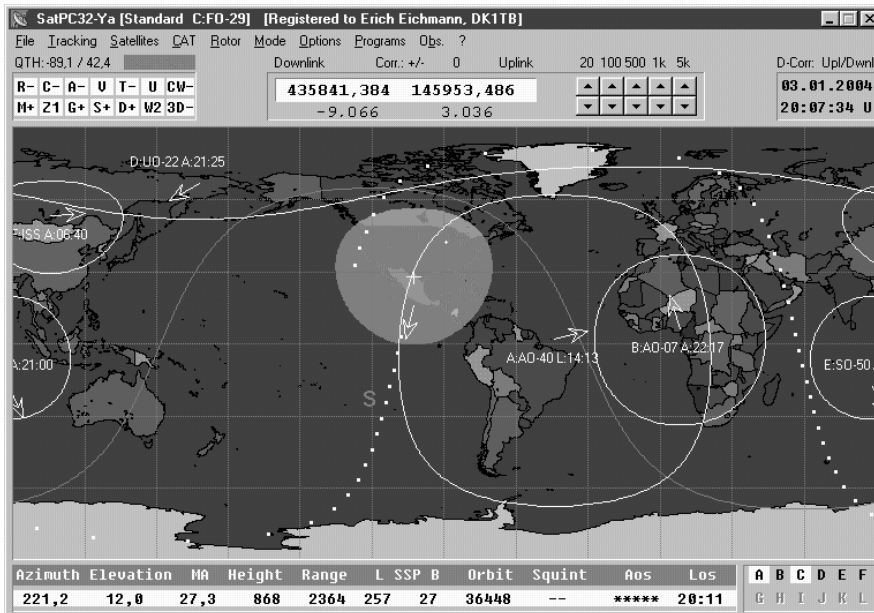
Price is \$45 for AMSAT members, \$50 for non-members, postpaid on CD-ROM.

A demo version may be downloaded from <http://www.dk1tb.de/indexeng.htm>

A registration password for the demo version is \$40 (members), \$45 (non-members).

Order by calling 1-888-322-6728, or use the online shop at www.amsat.org.

The author DK1TB donated SatPC32 to AMSAT. All proceeds support AMSAT.



frequency channels, the nearly one hundred TNC parameters, and the variety of applications for this radio on orbit, the default configurations are absolutely critical to being able to maintain communications with the crew under all conditions. These five configurations reduce operations to these fundamental configuration baselines:

- PM1: Voice Operations (mono band)
- PM2: Voice Operations (cross band/repeater)
- PM3: APRS/Packet and BBS operations
- PM4: Attached PC and packet operations
- PM5: Emergency Voice and alternate 9600 baud packet operations.

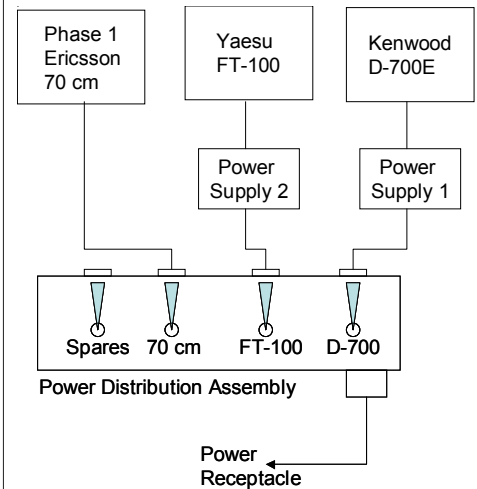


Figure 11
Power Distribution Schematic

PM-Off: No defaults. This mode is for knowledgeable licensed crew member's experimentation

The PM's remember the following types of parameters for the radio:

- Default Channel for LEFT side and RIGHT side of radio
- Which side of radio the microphone and PTT will activate
- Which side of the radio the TNC will RECEIVE and on which side it will Transmit
- The function of the several “soft keys” on the radio front panel

While the MCP program stores all 200 frequency channels in the radio, the PM's do not store any combination of channel frequencies other than the initial two defaults for the left and right side of the radio. This means, that once a PM has been selected by the crew, this only configures the radio to a known default pair of channels. The crew member can still tune to any channel after that. Thus, with a push of two buttons and a rotation of the main dial, the crewmember can operate on multiple modes and different frequency pairs. While this architecture offers the ultimate in flexibility (millions of combinations), it also provides a user-friendly interface of the five PM's to always return the radio to a known initial state.

Each of the 200 memory channels can support separate TX and RX frequencies, offsets and PL or CTCSS tones. The D700 is a dual radio system and although it only supports two channels at a time, it is very important to remember that each channel consists of both a displayed RECEIVE frequency and a separate TRANSMIT frequency. Thus, at any time, there can be up to four frequencies involved in radio





Figure 12
Kenwood D-700
PM1 Crew Display

operations. Since the Microphone and PTT (for voice) can be using one channel and the TNC can be using the same or the other channel, or even can transmit on one channel and receive on the other, there are many conventional (e.g. simplex, split) and non-conventional (e.g. crossband, repeater, CTCSS-enabled command uplink digital channels, etc) ways to use these combinations for ARISS.

Yaesu FT-100 Specifics

The ARISS technical team working on the Yaesu project has specified several modifications to the Yaesu radio system to prepare it for flight. These modifications include:

1. Replacing the power cable and the microphone and control head cables with flight cables to allow certification of the hardware to the Russian requirements.
2. Reducing the maximum power output of the radio to 25 watts
3. Replacing the PVC RF cables and connectors on the back of the radio with SMA connectors. Attached to these are Teflon coated RG-142 antenna cables with N connectors
4. Tuner cable replacement with flight cables
5. Replacement of 6-pin data connector with an 8-pin connector. One of the additional pins on this connector supports a 12 V DC output capability.

Since the FT-100 supports HF operation and the WA4 antenna is a single 2.5 meter vertical the ARISS team felt that it would be best to supply a tuner with the radio to minimize SWR concerns and optimize signal output. See Figure 11. The ARISS USA team is working closely with the Yaesu team to modify their existing FT-100 auto-tuner for ham radio operations on ISS.

Development of the Yaesu system is ongoing, but is expected to conclude in early November 2003.

Power Distribution Assembly

One of the primary issues in a household is

sufficient and easy access to electrical receptacles. A similar issue exists on ISS. There just aren't enough receptacles where you need them. With the 3 radio systems being installed in the Service Module (Phase 1 70 cm, Phase 2 Kenwood and Phase 2 Yaesu), the need for electrical receptacles for the ISS ham radio system could become a major issue.

The power distribution assembly, see Figures 11 and 13, resolves this problem and several other potential issues on ISS. The power distribution assembly allows the ISS ham system in the Service Module to be plugged into only one ISS receptacle. It also provides a power shutoff capability via

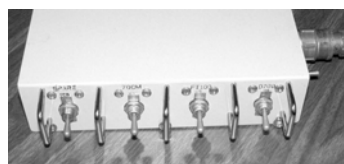


Figure 13
Power Distribution Assembly

switches and circuit breaker protection for each radio system. This not only provides an addition level of safety but also provides an additional shutdown feature that is critical for satisfying the ISS EVA safety requirements. With the power distribution assembly, there will be no need to plug and unplug ISS ham items due to insufficient receptacles. Thus, this assembly serves to reduce wear and tear on the power cables, improving system safety.

The Power Distribution Assembly is being developed by the USA team with strong support from the Russian team. While the unit will be fabricated in the US, several of the parts, particularly the electrical connectors, are Russian supplied. The current plan for the Power Distribution Assembly is to fabricate the flight unit, certify it for flight in the US and in Russia and then fly it on-board the next space shuttle. Since the Yaesu system will not be deployed until the Spring of 2004, this development and delivery schedule appears to make sense.

Power Converters

Two fully redundant, flight certified power converters were developed by the Russian Energia team and were supplied to the ISS ham team for use as part of the Phase 2 radio system. These power supplies convert the 28 VDC ISS power to 13 VDC for use by the Kenwood and Yaesu radio systems. Since the power converters are fully redundant, the ISS ham team will have adequate power capabilities for all the radio

systems even if one of the power converters fail.

Phase 2 Delivery, Testing and Checkout

The final version of the flight MCP software was delivered to the Russian team by the USA team on July 17, 2003. Just prior to this, the Kenwood Japan team delivered the final firmware load to the Kenwood Japan (Bermos) team for installation into the D-700 radio. The Bermos team and the ARISS-Russia team, led by Sergej Samburov, completed the hardware and software modifications to the radio system in late July and readied the Phase 2 hardware system for flight. The initial set of Phase 2 hardware, including the Kenwood D-700 radio, interconnecting cables, power converters, and RF switching system were delivered to the Baikonur Cosmodrome in Kazakhstan in early August. The Phase 2 hardware was launched on the Progress 12P rocket on August 29, 2003 and docked with the ISS on August 31. The Velcro table is already



Figure 14
Power Converter

on-board ISS and is awaiting equipment installation.

The Phase 2 equipment is currently "yellow tagged" meaning that we need to accomplish some additional tests prior to on-board hardware integration and testing. A series of tests are being planned for early November 2003 at the KIS facility (Service Module engineering model equivalent) located at Energia in Korelev (Moscow area) Russia. The Russian and US team will be conducting tests in this Service Module equivalent to validate that the Phase 2 and 70 cm and 2 meter Phase 1 systems are compatible with the other electrical systems on the Service Module. We will also conduct some RF testing with the flight-identical antenna systems and the Phase 1 and Phase 2 hardware. Once these tests are successfully completed, the yellow tag can be removed and hardware installation can begin.

The current plan is for Mike Foale and Alexander Kaleri to install the Phase 2 and

Phase 1 70 cm hardware on Expedition 8. The plan is to perform hardware installation and checkout in mid to late November 2003. The remaining Phase 2 hardware, including the Yaesu radio system is planned to be launched on the Progress 14P flight that is planned for January 2004.

FUTURE HARDWARE DEPLOYMENTS

Follow-on Phase 2 Hardware

Two future projects are envisioned to improve the capabilities of the Phase 2 system. These include the development of the tuner for the Yaesu radio system and the certification of a Standing Wave Ratio/Power meter. These two projects will be developed and flight certified by the US team and flown on a future shuttle flight.

SSTV

In the near future, a Slow Scan Television (SSTV) system will be deployed on ISS. The SSTV system for the ISS ham radio station is currently in development. This system will consist of a software interface, developed by the MAREX-MG team and a hardware interface developed by the AMSAT-NA hardware team. Prototype hardware and software systems have been developed and the flight system fabrication has started. The SSTV system will allow digital still pictures to be uplinked and downlinked in both crew-tended and autonomous modes. The ARISS team expects the SSTV system to be flown on Progress flight 14P in January 2004.

CONCLUSIONS

The ARISS-international team, with help from Kenwood and Yaesu, has developed the ISS Phase 2 ham radio system. The Kenwood system is currently on-orbit and will be soon operational on ISS. The team expects that the Yaesu system will be operational in Spring 2004. This multinational development effort presented many challenges to the team. Despite these challenges, the tremendous teamwork and optimistic spirit resulted in an outstanding new capability on ISS that we expect to set the standard in space for years to come.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the tremendous support, teamwork and volunteer spirit of the ARISS-International team in making this hardware system come to fruition. Technical, financial and administrative support by the ARISS member organizations, the AMSAT organizations and IARU organizations (ARRL in the USA) continue to be crucial to the success of the program. Also special recognition is in order to NASA, Energia,

Kenwood and Yaesu. The ARISS team continues to be indebted to them for all their in-kind contributions and support. Together we are pioneering the new frontiers of Amateur Radio and educational outreach.

DEDICATION

This paper is dedicated to the memory of Roy Neal, K6DUE. Roy's tireless pursuit to make Amateur Radio on human spaceflight missions a permanent capability was an inspiration to us all. We feel privileged to have realized his vision on ISS during his lifetime. We have more solidly cemented that permanence with the delivery of the Phase 2 hardware system. Our thoughts and prayers are with you old buddy.

REFERENCES

1. Bauer, F., McFadin, L., Steiner, M., and Conley, C., "Amateur Radio on the International Space Station - the First Operational Payload on the ISS." Proceedings from the World Space Congress, 2002
2. Watarikawa, H., and Aota, S., ARISS D-700 Users Manual, July 15, 2003
3. Bauer, F. and McFadin, L., "SAREX Hardware Configurations and Flight Operations Support" Proceedings of the AMSAT-NA Tenth Space Symposium, October 1992.
4. Bauer, F. and Marchant, W., "Amateur Radio on the International Space Station," Proceedings of the AMSAT-NA Sixteenth Space Symposium, October 1998.
5. "Joint NASA-Energia Meeting on Amateur Radio for the International Space Station Held at Johnson Space Center, Houston, Texas 22-27 January 1999, The AMSAT Journal, July/August 1999.

For more information on the ARISS program, you are welcome to visit the ARISS web page at:

<http://ariss.gsfc.nasa.gov> or

<http://www.rac.ca/ariss> 

Editor's Note:

This article was originally presented at the 2003 AMSAT Symposium and published in the proceedings. Some of the text is dated due to the time delay but is still of interest to the AMSAT community.

What Do You Want To Do While A Satellite's Not In View? GET THE ATV BUG!



70cm 20W ATV Transceiver TC70-20S \$549

Use your same 70cm satellite beam with this unit to show your shack, satellite tracking, home video tapes, retrans Shuttle video, do public service, etc.

Just add camera, TV set and 13.8V@5A - it's easy!

Check out our web site: <http://www.hamtv.com>

You can download our 10-page catalog, application notes and lots of good info there.



P. C. Electronics

2522 PAXSON LN, ARCADIA, CA 91007

CALL (626) 447-4565



SO-50 Now Open

Greetings,

I have been advised that I can now publish the tone to open SO-50 to all users, as the power availability appears to be good. To switch the transmitter on you need to send a CTCSS tone of 74.4 Hz.

The order of operation is thus: (allow for Doppler as necessary)

- 1) Transmit on 145.850 MHz with a tone of 74.4 Hz to arm the 10-minute timer on board the spacecraft.
- 2) Now transmit on 145.850 MHz (FM Voice) using 67.0 Hz to PT the repeater on and off within the 10 Minute window.
- 3) Sending the 74.4 Hz tone again within the 10 minute window will reset the 10-minute timer.

Some additional information:

The spacecraft repeater consists of a miniature VHF repeater with a sensitivity of -124 dbm, having an IF bandwidth of 15 kHz. The receive antenna is a 1/4-wave vertical mounted in the top corner of the spacecraft. The receive audio is filtered and conditioned then gated in the control electronics prior to feeding it to the 250 mW transmitter. The downlink antenna is a 1/4-wave mounted in the bottom corner of the spacecraft and canted at 45 degrees inward.

73,

Robin Haighton, VE3FRH
President AMSAT-NA 



P3E-Status

by Peter Gülzow, DB2OS

Translated from German by John Bubbers, W1GYD

First published in the AMSAT-DL Journal, March/May 2004

Another meeting took place in Marburg on April 4, 2004 to clarify the transponder situation and the antennas on P3E. On the previous day there was a meeting of the Board and the Project management to discuss the status of the modules and components of the P3E satellite and to deal with measures to take at the critical points.

The participants at the transponder meeting on April 4 were: Frank Sperber, Heike Straube, Ralph Lampenscherf, Karl Meinzer, Peter Gülzow, Henning Rech, Freddy de Guchteneire, Helmut Reidel, Ulrich Müller.

Currently the U/V transponder and the S-band transponder are especially critical, however, a solution was found to hopefully finish these projects in a timely fashion. Unfortunately several HF specialists have left Amateur Radio completely so we are experiencing these results. At earlier projects the module makers practically over-ran us. It now becomes more difficult to find competent people with suitable motivation. The general shortage of HF engineers and naturally the economic conditions of many candidates is also felt here.

To help remedy this there will be a cooperative work program with the technical college in Coburg.

Project assignments for seventh semester students majoring in information and communication technology will be offered under the direction of Jochen Jirmann, DB1NT. An HF transponder that will fly on a satellite is certainly an interesting subject. At the meeting many questions by the module builders were clarified, especially space-qualified hardware requirements.

Battery Problem Solutions

Many members will certainly ask what after-effects followed after the failure of the batteries on AO-40. In the first instance it was planned to use only one main battery for P3E and to forgo a back-up battery based on space and weight considerations. Based on the actual events on AO-40 this subject has to be viewed from a different aspect. The basic case for the failure of the main battery on AO-40 is to be found with great probability in a short circuit in one of the three distributed battery banks, relative to the cabling, as a possible result of the propulsion system damage shortly after the launch. There is an apparent sudden voltage

loss with that kind of a short circuit. In a normal 'death' of a battery in which several cells probably short circuit, there would be sufficient time to switch over to the back-up battery and to charge it up. The bi-state (latching) relays on AO-40 are fed from the bus voltage of 24 V and still operate at 14 Volts, according to brief experiments done at the previous P3D integration laboratory in Orlando, Florida, but not if the voltage is lower. The on-board computer receives its own 10 Volts, and obviously still operates, but this is not sufficient voltage to switch over the batteries.

On the Mars Rovers Spirit and Opportunity the temperature is the determining factor for the life expectancy of the batteries and therefore a switch over was provided where the battery is completely cut off from the supply bus if the battery voltage is too low because of a defect. Only once the energy cells deliver energy again on the Mars day, Mars Rover and the on-board computer wake up. At night all systems are dead, but at least in the daytime experiments can be undertaken.

On our satellite it isn't quite as simple, because the linear transponder needs the battery as a buffer for optimum energy supply from the solar cells to filter out performance peaks. Very limited operation would be possible without the battery. An auxiliary logic system had been provided on AO-40 in which there was always one of the batteries in operation or also both, but operation is never possible without a battery. A electronic switch with power MOSFETs is being developed that will still operate at low voltages after a battery defect to disconnect the defective battery so that the AO-40 problem is not repeated on P3E or P5A. If the switching needs to operate reliably and actually increase the redundancy, then P3E will also get a supplementary back-up battery. This AUX battery will be smaller, however, so that certain limitations must be made.

France Telecom and AMSAT-DL Sign a License Agreement for the Use of Turbo-Codes

Shortly a license agreement for the use of Turbo-Codes could be signed between the representative license owner "France Telecom" and AMSAT-DL. Thereafter the non-commercial use of the so-called Turbo-Codes will be permitted by AMSAT-DL for

its missions P3E (earth orbit, launch 2005/2006) and P5A (Mars mission, launch window 2007 or 2009) as well as the AO-40 satellite already in orbit. Included are the earth segments of the satellite users as long as the use is limited to the use of the designated space travel missions. Distribution of sub-licenses through AMSAT-DL is therefore not anticipated. AMSAT-DL has sole control for the use in conjunction with its future missions.

Turbo-Codes is a special, rearward looking method to make radio signals robust against noise incursions and a very low signal/noise ratio. In comparison to the forward error correcting code (FEC) combined with a convoluted code (Viterbi), the use of the patent protected Turbo-Codes for the Mars mission promise a 3 – 4 dB improvement in the signal paths over the ongoing methods. The signal paths between earth and the AMSAT-DL Mars sonde P5A will either transfer more data in the same length of time or the ground station antenna requirements can be reduced by approximately one third, depending on which requirement is in place.

The first prototypes for encoding and decoding signals using Turbo-Codes by the AMSAT-DL team were developed immediately after the signing of the agreement and have already demonstrated their usefulness for the Mars mission of the AMSAT-DL

IHU-3 News

Meanwhile, Lyle Johnson, KK7P, has been able to make some progress in the implementation of the new IHU-3 prototype. Although there are a smaller number of building blocks, the design and implementation are quite complex. Many functions are buried in the FPGA's the programmable building blocks.

A new IHU was necessary because the complete satellite bus of P3E is controlled through the CAN-bus and new paths are laid out in the communications techniques. The demands of Turbo-Code signals additionally require additional hardware and increased demands on the performance capabilities of the processor. The new IHU-3 is also to be installed on the Mars mission. There will be at least two, maybe even three new IHU-3 computers on P3E, in which each IHU can be used as the primary on-board computer. Compared to previous systems, this first became possible with the introduction of the



CAN-bus on the satellite. The third IHU-3 will possibly function as a RUDAK system and will transmit pictures from different cameras to ground, for example.

Naturally, IPS will be introduced as the operating system again, in which several new modifications in the structure will become necessary, since the modem is completely based on software and this part must consequently operate from a flash memory. The previous IHU-2 and IHU-3 could be fully reset and loaded with software, while the IHU-3 is dependent on the software in the flash memory. However, a combination of several software and hardware watchdogs and other mechanisms are provided so that it cannot end up in a catastrophe. So the new IHU-3 offers at least the same reliability as the good old IHU-1.

Karl Meinzer, DJ4ZC, will personally concern himself with the adaptation of the hardware related parts of the IPS, supported by James Miller, G3RUH, and Stefan Eckart, DL2MDL, who has taken on the translation of the Turbo-Codes. 🌐

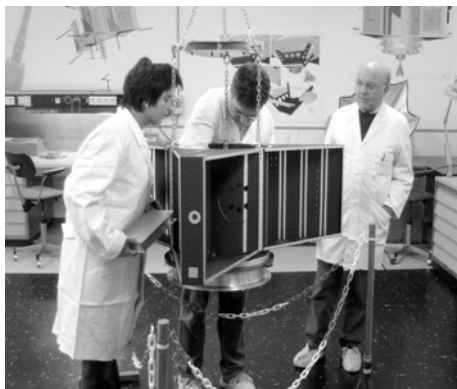


Figure 1
The mechanical integration of P3E makes progress in the AMSAT-DL laboratory in Marburg. (left to right: Heike Straube, Peter Osswald and Karl Meinzer)



Figure 2
The participants of the transponder meeting on April 4. From left to right: Frank Sperber, Heike Straube, Peter Güllow, Freddy de Guchteneire, Henning Rech, Helmut Neidel, Karl Meinzer, not in the picture Ulrich Müller, Ralph Lampescherf

AMSAT at Dayton 2004



At the Amber Rose - see anyone you know?

Steve Diggs, W4EPI, demos an FM bird



Gould Smith's Echo presentation



Gould, Keith and Robin are ready for the crowds!



The Forum Crowd



Drew Glasbrenner, KO4MA, uses his HT to demo an FM bird

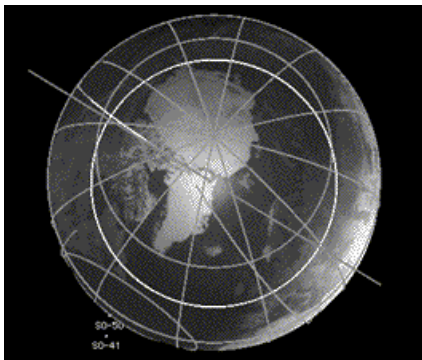


The AMSAT booth - the rush is on!



MacDopplerPRO X

The premier Satellite tracking and station automation application for the Macintosh - OS 9 & OS X



MacDopplerPRO X gives you a seat right in the heart of the Operations & Command Centre for every satellite in orbit. In fact up to thirty two front row seats at the same time, providing any level of station automation you need from assisted Doppler Tuning and Antenna Pointing right on up to fully automated Satellite Gateway !

It will calculate the position and relative velocity of the satellite you are tracking and automatically adjust the Doppler shift on both transmit and receive as well as pointing your antennas with predictive dead spot crossing so that a pass is never interrupted by the beam heading passing a dead spot.

MacDopplerPRO X provides separate windows for the map (2D or 3D), the radio controls, and the sorted table of upcoming satellite passes. A Horizon window graphs upcoming passes as a function of elevation over time for status at a glance.

Now available at a special member discount price from AMSAT !

martha@amsat.org
850 Sligo Ave.,
Silver Spring MD,
20910-4703 USA.
(301) 589-6062, (301) 608-3410 (Fax)

Dog Park Software Ltd
www.dogparksoftware.com

Do you still use manual tuning to remove Doppler changes? Why not automate?

Uni-Trac 2000 will automatically tune your Receiver (and Transmitter) to compensate Doppler frequency changes. Uni-Trac will also STEER your Antenna !

Uni-Trac 2000, including Interface Cable \$280.00
FOB Concord, Mass. 01742, USA.



Spectrum International, Inc.,
P.O. Box 1084,
Concord, Mass. 01742, USA.
Tel: (978) 263-2145
Fax: (978) 263-7008

SSB ELECTRONIC USA

PHASE 3D Equipment Headquarters

SSB Electronic USA features world class VHF - UHF - SHF equipment. The latest gear from: SSB Electronic, Kuhne Electronic - DB6NT, M2 Antennas, Beko Electronic, EME, Procomm, AIRCOM PLUS, AIRLINK, ECOFLEX and WINRADIO is available.

- Mast Mounted Preamplifiers 144 - 2400 MHz.
- Ultra Low Noise LNA's 50.0 MHz. 24.0 GHz.
- Transverters 50 MHz. - 24.0 GHz.
- Antennas - Rotors
- Downconverters and TX Upconverters for all P3D frequencies
- Mode "S" Downconverters
- Mode "L" TX Upconverters
- Linear Amplifiers 50 MHz. - 24.0 GHz.
- Ultra Low Loss Coaxial Cable
- Transverter Kits 1.2, 2.4, 5.7 & 10 GHz.
- Parabolic Dishes

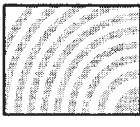
So What's New ?

BEKO Electronic: 144 MHz. - 1296 MHz. Linear Amplifiers 100 Watts - 1200 Watts

DB6NT Electronic: MKU 24 OSCAR Mode "S" Downconverter IF 144 or 432 MHz.
MKU 10 OSCAR 10.451 GHz. Down Converter
MKU 24 G2 OSCAR 2.4 GHz. Transverter 1 Watt
MKU 57 OTX 5.6 GHz. OSCAR TX Upconverter *plus more.....*

ECOFLEX - LLC Super Flexible Low Loss Coaxial Cable

SSB Electronic: UEK-3000SAT Mode "S" Downconverter IF 144 or 432 MHz.
UTM-1200 DLX Mast mounted 1269 MHz. 15 Watt TX Upconverter
UTM-1200-1 1269 MHz. 1 Watt TX Upconverter
SP-2000 & SP-7000 Heli-Filtered Mast-Mounted Preamps *plus more.....*



SSB
Electronic USA

For complete specifications and prices, please visit our WEB SITE: www.ssbusa.com

Phone 570-868-5643

New Hours: MTWTFSS
9:00 AM - 11:00 PM

124 Cherrywood Dr.
Mountaintop, PA 18707





AMSAT

22nd Space Symposium and Annual Meeting



8-10 October 2004 – Arlington, Virginia

Followed by the Amateur Radio on the International
Space Station (ARRISS) International Delegates Meeting
10-13 October 2004

HOTEL:

Crowne Plaza National Airport – A first class, full service hotel in Crystal City, Arlington, Virginia. Our rate: \$89/day + tax. Parking: \$11/day. Reservations: 1-703-416-1600. Ask for AMSAT/ARRISS Special Rates.

TRANSPORTATION:

RAIL: AMTRAK service to Alexandria or Washington, DC; easy connection by Metrorail or taxi.

AIR: **Washington National Airport (DCA)** – Less than 1 mile; Metrorail and FREE Hotel Shuttle available.

Dulles International Airport (IAD) – About 22 miles. Dulles is a major hub airport with world access.

Baltimore-Washington International Airport (BWI) – About 30 miles.

General aviation – See: <http://www.dcpilots.org>.

CAR: I-395 to US-1 South.

SPECIAL FEATURES:

Sunday Field Trip: Smithsonian Air & Space Museum: Stephen F. Udvar-Hazy Center. NEW! AMAZING!

Fun for all the family: Free museums in Washington, DC. See www.AMSAT.org for more details.

REGISTRATION:

Description	Cost	How Many?	Amount Included US\$
Symposium and Proceedings	☐ \$35 until 8 SEP 2004		\$
	☐ \$40 after 8 SEP 2004		\$
	☐ \$45 at the door		\$
Saturday Night Banquet	☐ \$35		\$
Sunday Bus to Udvar-Hazy Center 12:00-5:00 pm, Sunday, 10 October, 2004	☐ \$15		\$
ARRISS International Meeting	☐ FREE		N/A
Name:	Call Sign:	Method of Payment	Total
		☐ Check (drawn on USA bank) US\$	
Guest(s):	Call Sign(s):	☐ VISA ☐ MC ☐ Discover ☐ Am Ex	
Address:	Day Phone:	Card #	Exp. Date
City/State/Zip	E-Mail:		
Province	Signature		

SEND TO: **AMSAT**
850 Sligo Avenue #600
Silver Spring, MD 20910 USA
<http://www.AMSAT.org>

FAX: 1-301-608-3410
TEL: 1-301-589-6062
TOLL FREE: 1-888-FB-AMSAT (USA)
E-MAIL: martha@amsat.org



A Cheap Signal Source for S-Band

By Peter Carr, WW3O, and Rod Kreuter, WA3ENK

This all started when my wife walked into our kitchen while the counter top was littered with power supplies, power inserters, an IFR A-7550 1 GHz spectrum analyzer and a barbecue grill antenna pointed at the microwave oven. I was deep into the study of the broadband signals emitted by the oven as it merrily heated a glass of water. She asked what I was doing so I opened the oven door and showed her that the signal of the analyzer went to flatline. She told me that it was all very interesting but that kitchens and electronics were not compatible. I quickly removed the equipment to the basement!

The experiment showed that the chain of equipment was working. The oven emitted signals around the 2400 MHz region and the antenna/down converter was processing the signals. However, I had no way to know the signal intensity or to use the oven to tune the system for maximum sensitivity. What I needed was a battery powered lightweight small signal source that could be used in the basement and also on the house roof.

I discussed this situation with Rod Kreuter, WA3ENK, who is a certified genius at producing unusual electronic circuits. He took a couple of days to come up with the circuit presented here. (See Figure 1.) Simply put, it uses a 32 MHz, 5-volt resonator as a frequency source. The buffer/line driver chip produces a signal at the 75th harmonic that is 2400 MHz. Power is supplied from an AA size 4-cell battery

holder for a Vcc of 6.0 volts. Since I had not specified that the thing had to be pretty, Rod used the time honored "dead bug" method of parts mounting. A piece of copper clad circuit board was cut to the same size as the battery holder. The resonator and IC were glued in position with their leads sticking upward. Pieces of resistor lead were used to strap leads of the IC as shown. Soldering leads directly to the copper clad board completed the ground connections. The battery negative wire was also soldered to the copper board. Various resistors and capacitors were soldered to pins on the resonator and IC and mechanically supported by the ground connections. The lead from the 51-ohm resistor was left at its "natural" length and used as the antenna. The schematic diagram indicates the parts placement just as used on the actual unit.

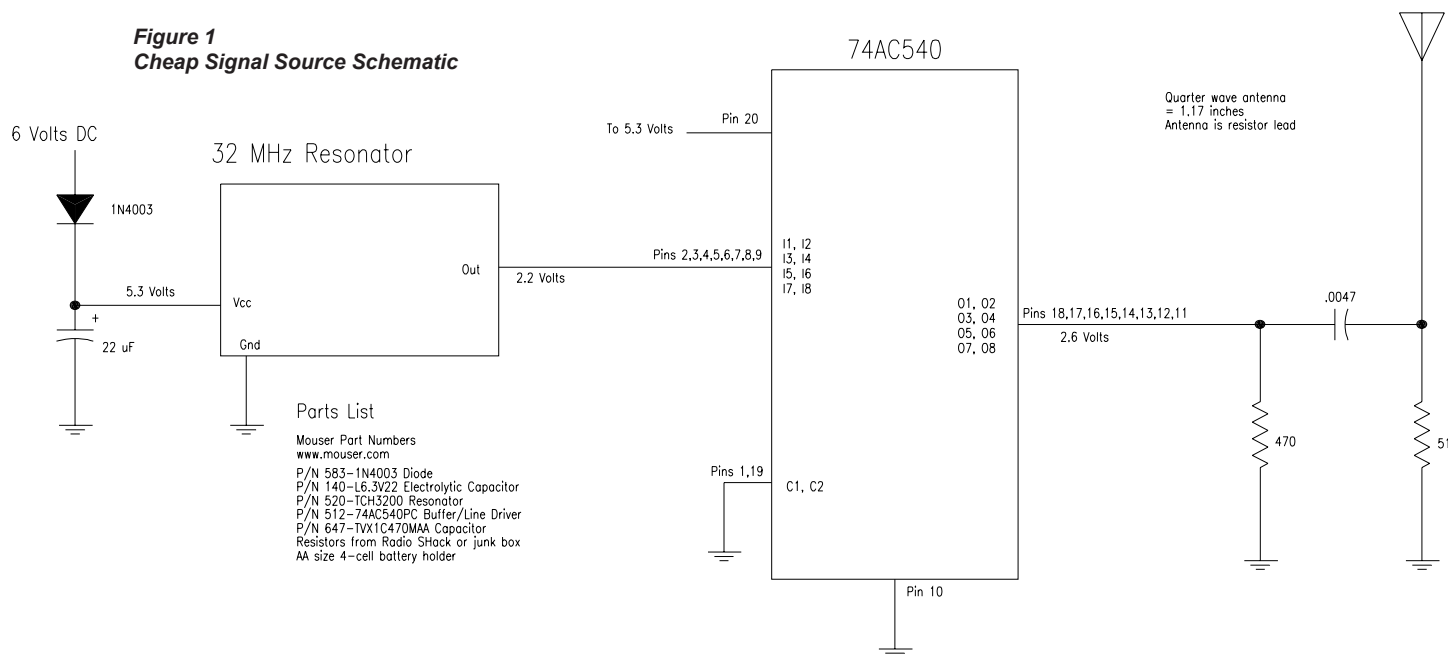
I installed 4 cells in the battery holder and watched as a nice signal spike appeared on the analyzer trace. After doing a "happy dance" around the equipment, I began testing the new signal source. The antenna and external downconverter shown on the basement floor (Photos 1 and 2) are destined for use as a portable receive station for camping and mountain top expeditions. I plan to add a small TV tripod for support and simply clamp the antenna in position after acquiring the satellite signal.

Testing began by powering up the signal source and placing it in front of the antenna. If the source was moved away from the

downlink antenna the spike decreased in amplitude. Similarly if the circuit was moved to one side of the antenna beamwidth the spike got smaller. One test I wanted to try was to move the antenna pickup in and out of the focal point of the section parabolic type antenna and tune for maximum signal. While sitting cross-legged on the basement floor behind the antenna I could watch the analyzer and slide the white square shank of the pickup in and out of the sleeve. The shank had been secured by a single long bolt and nut. The final position of the shank was slightly closer to the antenna than the original location. The spike amplitude increase was not very much but I took comfort in knowing that the total antenna system was now correctly tuned.

The separate downconverter was an old Conifer unit originally used in Multipoint Multichannel Distribution Systems (MMDS), also known as wireless cable TV. The input circuit was a ring mixer and only needed a new crystal to bring it up to 2400 MHz. However, the mechanics of the old unit were pretty poor so that it displayed amplitude changes when moved around. The fault was in the N-type connector where corrosion had caused a poor ground. I removed the cover from the unit and wiggled various parts while watching the analyzer. When the N connector and attached cable were moved the display would come and go. After doing the repairs of the connector I repeated the test and the signal was solid copy.

Figure 1
Cheap Signal Source Schematic



I've been using a larger section parabolic antenna with an AIDC 3731A downconverter for several years on the house roof. (See Photos 3 and 4.) It sits between a 70 cm crossed yagi and a 2 meter, 5-element Yagi on the az/el mount on the peak of the house roof. The downconverter is built into the support for the pickup and has an "F" type connector at the output. The output is in the 145 MHz range so RG-6 type cable runs down into the shack to a power inserter. DC power (12 volts) is duplexed onto the cable to power the electronics while the signal is passed through to a Yaesu FT-290 all-mode transceiver. This rig is equipped with an S-meter, which appeared to be rather nonlinear. It would jump from no signal to a "pegged" condition so quickly that fine-tuning the antenna with the controls was very difficult. The next project was to find out how well the roof mounted S-band antenna system was working. There is a chimney for our fireplace located about 40 feet from the antennas. I crawled up onto the roof and placed the signal source on the chimney and connected the batteries. The position of the source was at about zero degrees of elevation from the antenna.

I returned to the basement and set the antenna controls to zero elevation and then swung around toward the source while watching the S-meter. As the antenna arrived at the correct azimuth the meter came up and pegged. It appeared that there was a range of about 12 degrees of azimuth where the meter pegged. It was obvious that the source was too powerful at that range to be of use. I went back up on the roof and adjusted the

resistor lead "antenna" of the source so it laid horizontal to the copper clad circuit board but did not touch. I also oriented the source so the little antenna was end-on to the satellite array. Back in the basement I repeated the test and found that the S-meter would only deflect about half way at maximum signal. I did notice that while swinging the array left and right that the S-meter did jump indicating that something was loose. I returned once more to the roof and checked the S-band antenna. The square aluminum pickup on the end of the AIDC 3731A unit was held in place by a single screw that had loosened up. Once this part was tight the signal indication on the Yaesu S-meter was solid and dependable.

While doing these tests and adjustments I made notes of the position and distance of the signal source for future reference. If I tried the same test with everything set up the same in a year I should get the same S-meter results. The idea is to gauge the aging of the antenna, cables, connectors and the electronics. Hopefully it will minimize the number of trips to the roof searching for problems.

The signal source has shown to be very stable in both frequency and output power. It could be mounted in some sort of enclosure, have an on-off switch and use a better antenna. Still, the results of the present unit seem to indicate that these accessories are not really needed. I just remove the batteries to shut it off.

The signal source sits on a shelf gathering dust most of the time. I wonder if I could use it with a small reflector to reheat my

teacup when it's not testing antennas?

I hope that you will find good uses for this circuit and that it will help to increase the fun of working S-band.



Photo 3

The roof top antenna system has a Cushcraft 2-meter, 5-element Yagi and a 70 cm, 4-element Yagi on a common boom. The opposite end of the horizontal boom has a 70 cm Cushcraft crossed Yagi. The S-band reflector and the AIDC 3731A downconverter are in the middle.

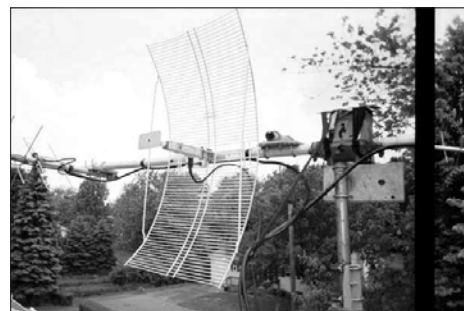


Photo 4

Just to the right of the S-band reflector is a 5-foot long horizontal mast used to counterweight the Yagis. Next to the mast is the vertical rotator. Both rotators are light duty TV antenna units from either Radio Shack or Alliance.

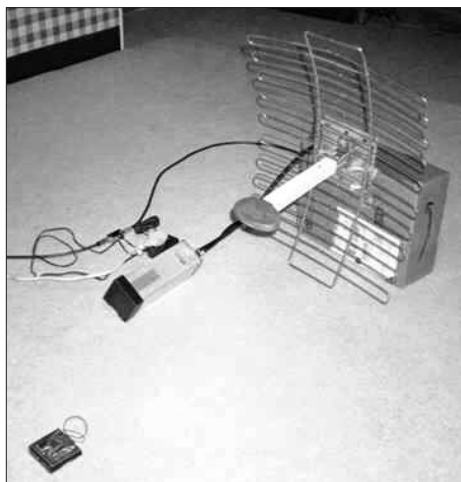


Photo 1

The MMDS antenna has a signal pickup at the focal point of the section parabolic reflector. The signal pickup has a length of RG-213 attached. The cable is terminated in an "N" type connector. The modified Conifer Model MDP downconverter has an "N" type input connector and an "F" type output connector.

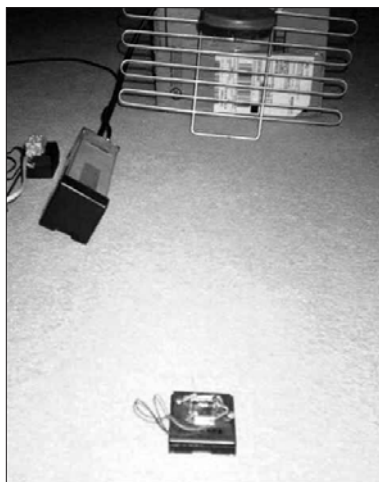


Photo 2

A small "T" shaped duplexer inserts DC voltage into the RG-6 cable that is attached to the "F" connector on the downconverter. This is powered by a "wall wart" type power source. Signal comes from the power inserter to the Yaesu FT-290 2-meter transceiver in the shack. Tests were run by connecting the IFR analyzer in place of the Yaesu.

Parts List: (easier to read)

Mouser Part Numbers
www.mouser.com

P/N 583-1N4003 Diode
 P/N 140-L6.3V22 Electrolytic Capacitor
 P/N 520-TCH3200 Resonator
 P/N 512-74AC540PC Buffer/Line Driver
 P/N 647-TVX1C470MAA Capacitor
 Resistors from Radio Shack or junk box
 AA size 4-cell Battery Holder



C-C Rider

A New Transponder Concept for Amateur Satellites

Tom Clark, W3IWI, w3iwi@amsat.org

Abstract

The Amateur Satellite Service has several microwave allocations in the 1-10 GHz range. AO-40 and the planned Echo satellite make use of the L/S combination permitted by combining the Amateur Satellite uplink allocation at 23 cm (1260-1270 MHz) with the 13 cm (2400-2450 MHz) band. Unfortunately, the FCC's "Part 15" and ISM rules have caused the 13 cm band to be seriously compromised by unlicensed consumer devices – microwave ovens, 802.11b and 802.11g wireless LANs, cordless telephones, video relay, etc.

Another very desirable amateur band is C-Band (5 cm) where the Amateur Satellite Service has a pair of 20 MHz wide allocations: 5650-5670 MHz is set aside for uplinks, paired with 5830-5850 MHz for downlinks. This spectrum is also at considerable threat; it is already experiencing the intrusion of 802.11a LANs, cordless phones and other unlicensed applications and has been targeted for expansion by a number of new wireless services. Unless we begin to use this band very soon, it may become a bigger sewer than the 13 cm band has become.

This paper presents a conceptual design for an "in band" transponder making use of the pair C-band allocations. Although microwave frequencies imply huge Doppler tuning problems for narrow-band signals typical of most amateur satellite activity, by placing a single local oscillator midway between the pair of frequencies (5750 MHz) we cancel 97% of the Doppler shift,

equivalent to operating at the difference frequency (180 MHz).

Until satellite resources can be deployed, low-cost versions of the transponder can be deployed at terrestrial locations as a wide-band "bent pipe" transponder with bandwidths capable of supporting many digital applications. These terrestrial developments could be a logical expansion of the ARRL's 13 cm "HSMM" "Hinternet" effort which makes amateur use of off-the-shelf low-cost commercial hardware.

The Microwave Spectrum

Let us begin by examining the amateur frequency allocations between 1 and 10 GHz in Table 1¹:

One sad lesson we have all learned from recent S-Band (2.4 GHz) experiences is that amateur activities have been seriously compromised by unlicensed users -- 802.11b & g WiFi, BlueTooth, cordless telephones, room-to-room TV links, microwave ovens, etc. We have learned that "listen only" and weak-signal services like the AO-40 downlink and EME are nearly powerless to convince millions of unlicensed users that our needs "trump" their usage. Since our applications are listen only (or mostly), we don't even announce our presence²!

Realizing that many future amateur activities will want more bandwidth, the ARRL has formed the High Speed MultiMedia (HSMM) working group to explore ways to adapt low-cost commercial wireless computer widgets for use in amateur

applications. The HSMM working group is headed by John Champa, K8OCL, (an AMSAT Director and Executive Vice President in the late 1980's). You may get more information on HSMM on the ARRL website³ and an excellent article on HSMM by N5KM is in the April 2003 QST⁴. The ambient RFI level from unlicensed devices has proven to limit coverage on HSMM links and I understand that the HSMM group and TAPR have begun efforts to figure out ways to QSY from 2400 MHz to either the 902-928 or 3300-3500 MHz amateur bands⁵ to improve operating range.

In this paper, I plan to concentrate on the idea of making a "fresh start" using the pair of C-Band Satellite allocations seen in Table 1: 5650-5670 MHz (uplink) and 5830-5850 MHz (downlink). Time is short - C-band has begun the process of becoming another S-band-like "sewer" with 802.11a wireless LANs, cordless telephones and the like. On the CISCO website one can find details⁶ of the current 802.11a WLAN channelization. At present, the 802.11a activity is confined to WiFi channels⁷ 149-157 in the 5740-5790 MHz range⁸. This segment is in the middle of the 5655-5925 MHz amateur allocation, but it has no overlap with either of the 20 MHz-wide Amateur Satellite allocations, as seen in Figure 1.

The wireless industry has formed the Wireless Industry Compliance Association (WECA) to promote the development of WiFi hardware⁹. WECA has petitioned the FCC for a large chunk of spectrum spanning 5470-5740 MHz (Channels 95-147). The recent WRC-03 has set aside the range 5150-5720 MHz for low-powered wireless usage on a worldwide basis. It appears that we must concede that the uplink region will soon be over-run. For C-C Rider to work, we need to be certain that the aggregate of all these low-powered signals will not overwhelm the distant satellite.

What is important to note is that, while the 5650-5670 MHz Amateur Satellite uplink band will soon be occupied by unlicensed wireless services, the 5830-5850 MHz downlink band is not under the same pressure (yet). We need to conduct some detailed RFI surveys of the existing environment. It is my hope that we will be able to make enough noise so that they can hear our uplink signals, and that our downlinks will be in the clear!

The rest of this paper will explore what we

Table 1: United States Microwave Allocations

Amateur Service		Amateur-Satellite Service	
Band (MHz)	Bandwidth (MHz)	Band (MHz)	Bandwidth (MHz)
1240 - 1300	60	1260 - 1270 ↑	10
2300 - 2310	10	-	-
2390 - 2450	60	2400 - 2450	50
3300 - 3500	200	3400 - 3410	10
5650 - 5925	275	5650 - 5670 ↑ 5830 - 5850 ↓	20 20
10000 - 10500	500	10450 - 10500	50
24000 - 24250	250	24000 - 24050	50

↑ means Earth-to-space (uplink) direction only

↓ means space-to-Earth (downlink) direction only



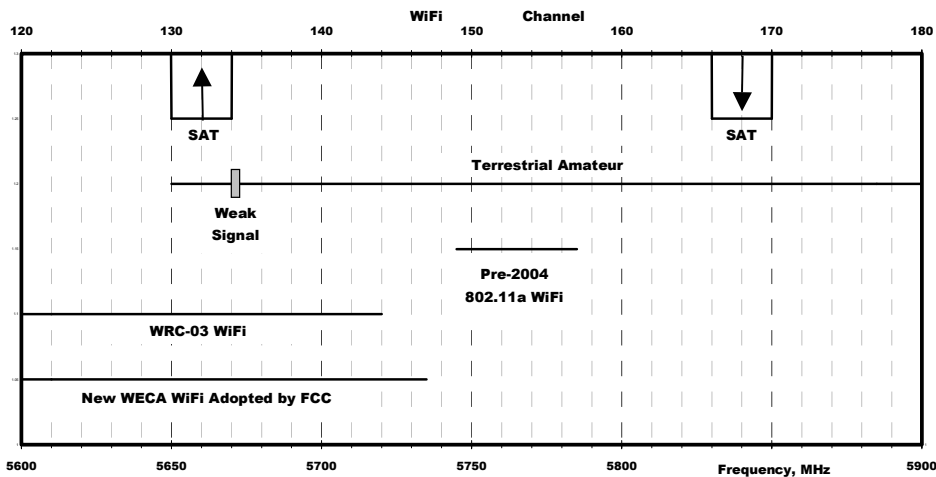


Figure 1: The 5600-5900 MHz C-band Microwave Spectrum

might do with our valuable and untapped resource – the matched pair of C-band allocations.

A Caveat

I want to stress that **none** of us have suitable C-band equipment in our shacks. Any program to develop satellite hardware will need to be matched with a parallel development of user hardware. These developments will undoubtedly make use of bits and pieces developed for consumer-grade applications, but I doubt that the consumer hardware *per se* will be suitable.

C-C Rider¹⁰ – A Proposal

This proposal suggests a new concept – a **single-band in-band¹¹ transponder**. By “in-band” we mean that uplink and downlink will use the same frequency band – in this case, the pair of C-band allocations seen in Figure 1. These two allocations are separated by 180 MHz, so the equivalent “Q” of the band separation filters needs to be $\gg [5800/180] = 32$.¹²

In Figure 2, I show a simplified block diagram of a possible “C-C Rider” transponder. One thing to note is that the design uses a **SINGLE** local oscillator at 5750 MHz; this frequency is midway between the uplink and downlink bands (separated by 180 MHz), and results in a 90 MHz IF. Note that this configuration has the LO above the receive passband, and below the transmit passband to create an inverting transponder. This has the interesting property that Doppler offsets are nearly cancelled – I say “nearly” because the Doppler on the uplink and downlink happen at frequencies that differ by 180 MHz. The net Doppler effects are the same as they would have been if the satellite were to operate at 180 MHz. Imagine – a microwave satellite with Doppler rates only one-third

of those we have learned to tolerate since the 1970’s Mode-B and Mode-J satellites!¹³

As with any other satellite program, the selection of a suitable orbit is a prime concern. The possibilities generally sort into two categories: LEO (Low Earth Orbit, with altitudes below about 1000 km and orbital period in the 90-120 minute range) and HEO (High Earth Orbit with altitudes greater than 10,000 km and periods longer than about 6 hours). By these broad definitions, the HEO category includes **GTO** (Geostationary Transfer Orbits), **GEO** (Geostationary orbits), **Molniya** (high inclination but otherwise similar to GTO), and the 12-hour orbits used by GPS and GLONASS navigation satellites.

LEO

If C-C Rider were to fly on a LEO satellite (~800 km), the Earth (and hence the users) fills much of the “down” half of the sky. A low-gain, wide beamwidth antenna is needed, like a small patch antenna (~6 dBiC gain). Computing the link budget¹⁴ we find that the both the uplink and downlink path loss is about 175 dB. Let’s put about 2 watts (output) of transmitter on the satellite.

On the ground, let’s use a 30 cm dish (or a 3x3 phased array of patch antennas, as we discuss later) and a 70K LNA. Under these conditions, the downlink will just support a 64 kb/sec digital link (or a 64 kHz analog passband) without the addition gain that would result from coding and error correction. The use of these techniques could push the digital rate up to ~100 kb/sec. The user uplink will require about 5 watts of transmitter.

The 26 dBiC up/downlink antenna has a beamwidth ~12 degrees. This will need to be pointed at the spacecraft (mechanically or electronically) at levels of 2-3 degrees. An overhead satellite pass will produce peak satellite motion in the $\frac{1}{2}^\circ/\text{sec}$ range, so the antenna will need to point very rapidly! In a later section I propose a possible “no moving parts” solution to this problem.

HEO

We all had a lot of hope in the promise of AO-40. Alas, the mission was only partially successful. We all have great hopes for AMSAT-DL’s P3-E satellite and AMSAT-

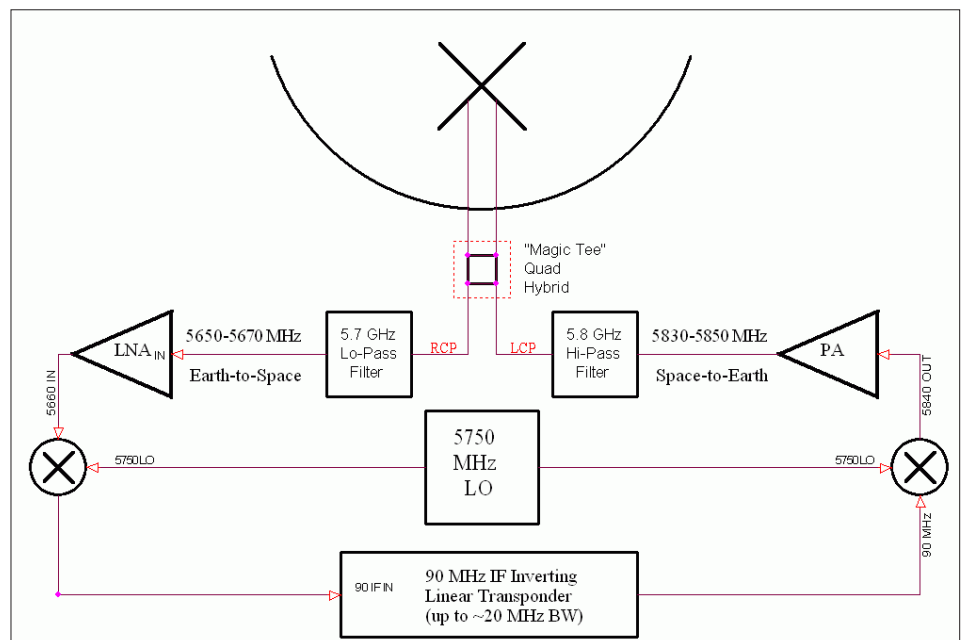


Figure 2
Simplified Design of C-C Rider Spacecraft Transponder



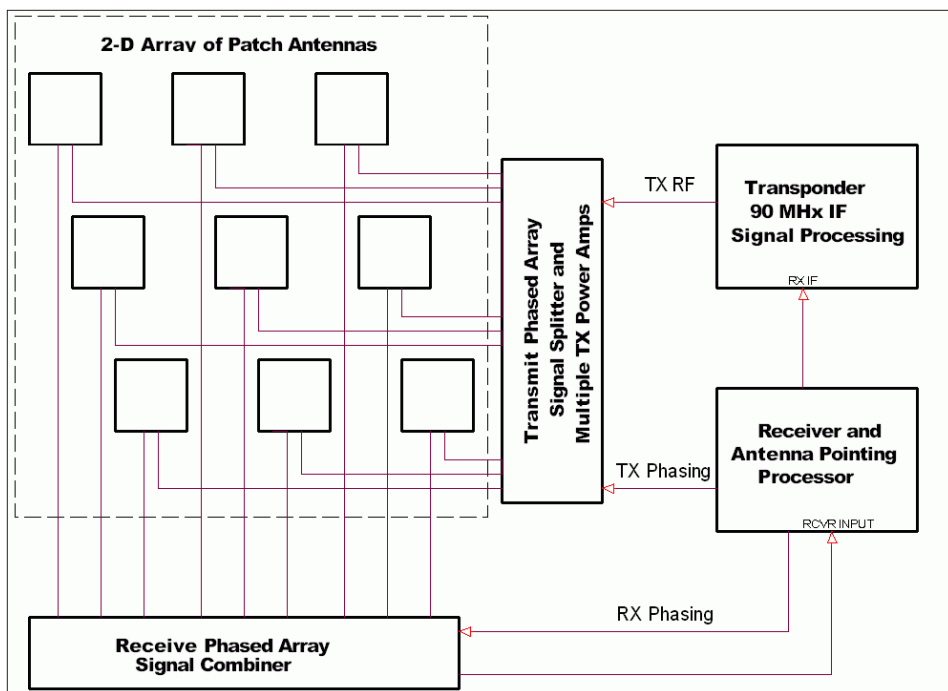


Figure 3
Using an Array of Patch Antennas Instead of a Dish

NA's Eagle satellite. Let's now look at how CC-Rider might work on Eagle.

To evaluate a typical HEO link, I assume a GTO or GEO satellite at ~36,000 km range. From that altitude, the one-way C-band path loss is 200 dB, 25 dB more than the LEO case we considered earlier. We also find that from the spacecraft, the earth now has a diameter of about 17°. To achieve a 17° beam, the downlink antenna can have only ~22 dB of gain, corresponding to an aperture of about 20 cm (i.e. about 3.51). Finally, I assume that we can generate 5 watts of RF.

On the ground I assume a 30 cm aperture (probably a phased array for reason described later), 70K LNA and 10 watts of transmit power.

Using a different link budget analysis tool¹⁵, we find that the C-C Rider could handle ~120 kb/sec of data without regeneration¹⁶, or about 600 kb/sec with regeneration. This could be apportioned out to multiple users for digital data or voice use following the model suggested by Phil Karn, KA9Q.

HEO Antenna Ideas

I envision that the same antenna will be shared by the uplink and downlink. Figure 2 showed how this might be done with a dish antenna. The inherent problem with this scheme is that the antenna's mechanical structure must be mechanically stabilized to levels of about 1/4 of the beamwidth. In the case of a LEO ground station, and for both the spacecraft and ground stations for HEO, antenna gain in the 20-25 dBiC range ends

up imposing a requirement of a few degrees on the antenna pointing. But with CC-Rider we have the interesting situation: The receive and transmit antennas share a common physical structure, and we want the two antenna beams to point in the same direction.

It is common practice in the professional

spacecraft world to use a "monopulse" feed. At the focus of a dish antenna we find an array of 4 antenna feeds which we might denote LEFT, RIGHT, UP and DOWN. Four separate receivers compare the RF phase of the signals seen by the L-R-U-D antennas. The antenna is then mechanically steered for zero phase difference. Then a 5th receiver makes use of the sum of all 4 antennas to get the full antenna gain.

Figure 3 shows a "no moving parts" approach we might use at C-band. I show 9 antennas arrayed in a 3x3 square (although a 4x4 or 5x5 array might be used if more gain is needed). On the receive side, each antenna is connected to a separate LNA and mixer, and then into a separate receive IF channel. The data from all 9 (or 16 or 25) is compared to measure the offset of the array from "boresight" relative. All the channels are summed to generate the low-noise signal needed by the transponder. As you can see, this is a phased array implementation of the traditional monopulse feed.

The receive signal processor has now determined how to point the antenna to optimize the received signal; the desired transmitter direction is precisely the same as we "peaked" the receiver! So the same processor knows how to generate the phasing data needed to point the transmitter in the same direction.

I envision that the transmit phased array will use a separate power amplifier for each

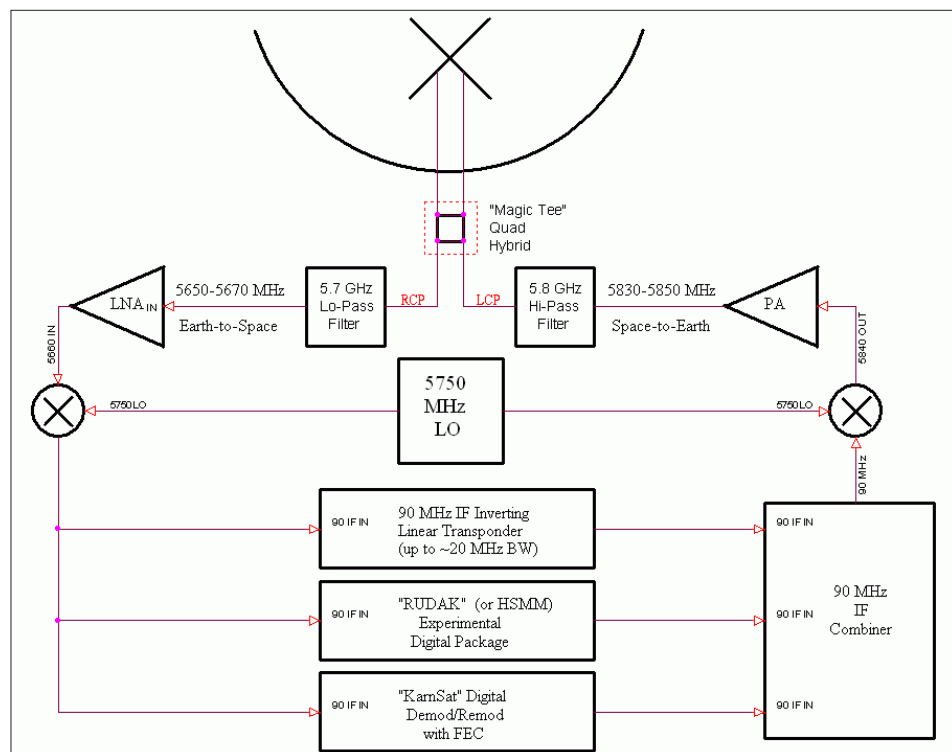


Figure 4
A Possible C-C Rider Spacecraft Transponder for Eagle

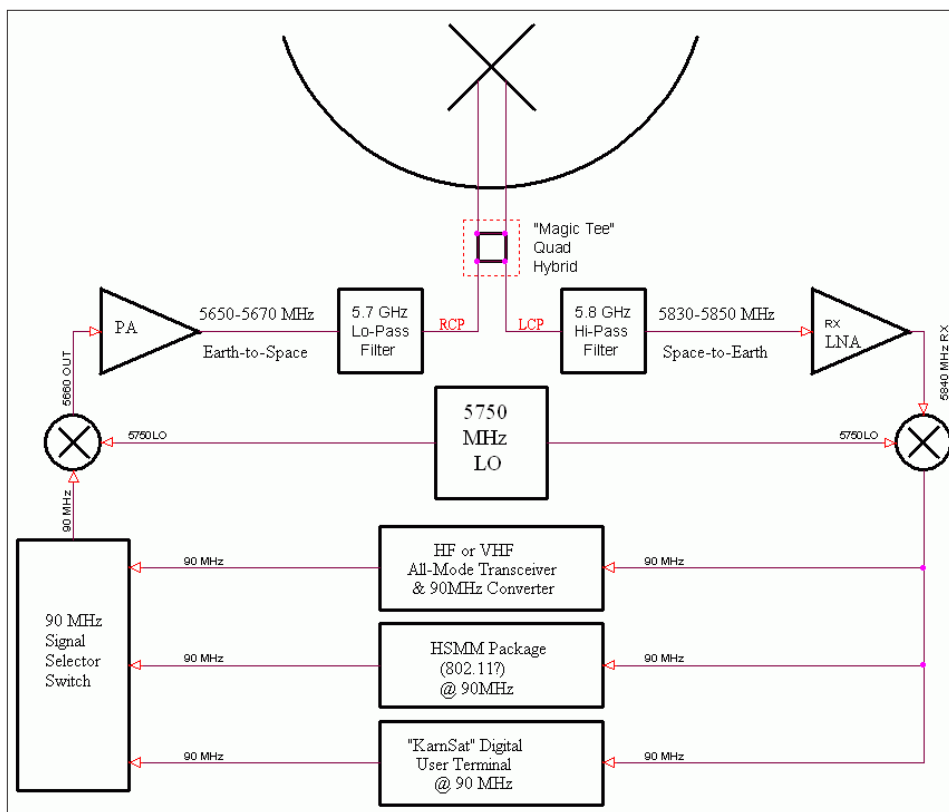


Figure 5
A C-C Rider Ground-Based User Terminal

antenna. This makes it feasible to use multiple low powered transmit elements, like those already available in the consumer marketplace¹⁷.

The use of separate receive LNAs and transmit power amplifiers for each antenna element provides a useful measure of reliability. If one of N elements should fail, then the array performance only drops by a factor of 1/N. Depending on spacecraft real estate, some extra elements could be flown to provide for the need for extra gain in an emergency. The amplitude illumination of the individual elements can be trimmed to provide active control of beams shape.

Some Other Ideas

So far I have not discussed any details of the inner transponder "guts". Figure 2 shows only a basic linear transponder. Certainly this could be made to work, and we could have a microwave replacement for Mode-B (or Mode-L/S). The interesting numerology of the two C-band channels causing Doppler to (nearly) cancel is neat. But we must ask if there might be alternate uses that make sense.

In thinking about these ideas, I asked myself a rhetorical question: What will be the thrust of Amateur Radio (and by implication amateur satellites) in the year 2018? Such a long vision is needed because it would take a few (let's guess 5) years before a new

concept could fly. What will be the "hot button" technology in 2008? Then we hope that any satellite we build will continue to be a viable, exciting, living entity for at least a decade if not more.

Let me use historical hindsight to think about the implications of the need for long-range vision.

Back in the early 1970's, when we had OSCAR-6 flying, our members yelled that Mode-A was what they needed. Everyone had 10M capabilities and a 2M TX was technically tough but possible. Many said "Why even consider Mode-B in OSCAR-7? - 70cm is like microwave and we mere mortal amateurs should not venture there!" Little did they know about all-mode, all-band radios!

In the early 1980's, as we were preparing Phase-3A, I saw the need for software to track elliptical satellites, so I wrote and published an "open source" ORBIT program. The naysayers said "Don't waste space in the AMSAT magazine - amateurs will never have their own computers". Little did they know that we would all have PCs connected to the Internet a decade and a half in the future.

The 1990's saw the birth of amateur digital satellites. AO-40 proved that L/S microwaves really are now in the grasp of amateurs. The folks planning missions now

need to think about where amateur radio will be in the 2010's.

One of the imaginative views of the future has come from Phil Karn, KA9Q. His thinking is based on the success of creative mixtures of RF, digital and signal processing like we have seen with modern cell phones and the satellite phones used by correspondents in the Middle East, which operate in the L/S band spectrum. DirecTV and similar systems at 12 GHz have shown that satellite-based microwave hardware can be combined with sophisticated digital coding and signal processing to provide robust, low-cost one- and two-way wireless paths.

Phil asked if we couldn't make similar capabilities for amateurs. Many urban amateurs have problems erecting antennas: can't we invent a system that could use technology developed by amateurs to provide the functional characteristics of 20 meters to the amateurs living in apartments?

Various AMSAT people have thought a lot about these ideas and have concluded that the answer is YES. We could augment Eagle to include some of the needed technologies. Let's morph Figure 2 into Figure 4 to see what the spacecraft might look like¹⁸. Here we see that the IF portion of C-C Rider has been replaced by three packages: a linear transponder, a "KarnSat" digital transponder and a 3rd package called (for historical reasons) RUDAK.

On the Ground As Seen from the User's Point of View

As I noted earlier NOBODY has the hardware that a ground-based user might need. If we build CC-Rider, we **must** develop the ground-based hardware at the same time. Figure 5 shows a view of what a user terminal might look like.

If you compare Figure 4 and 5, you will see few differences, except that the transmit and receive roles are reversed. Transmit filters become receive filters, up converters become down converters, etc. I envision that the microwave part of C-C Rider (inside the dashed lines in both Figures 4 and 5) would be constructed on 2-3 microstrip boards and there is little difference between the user terminal and the spacecraft - we can get double duty from a good RF design. This would also be possible with the phased-array alternative.

Terrestrial Possibilities

I mentioned earlier that the ARRL's HSMM effort has concentrated on the use of 2.4 GHz WiFi hardware, but that activity might want to try C-band. If some good RF hardware is developed that is suitable for both space and



Now Available by Mail:

PROCEEDINGS OF THE AMSAT-NA 21st Space Symposium and AMSAT Annual Meeting

Held October 17-19, 2003 in Toronto, Ontario Canada

A partial listing of the contents includes the following:

- * Mode L/S: Suitcase Portable
by Gerald Brown, K05E
- * C-C Rider: A New Transponder Concept for Amateur Satellites
by Tom Clark, W3IWI
- * L-Band Helix Antenna Array
by Clare Fowler, VE3NPC
- * Orbit Determination for AMSAT Spacecraft
by Ken Ernandes, N2WWD
- * AO-40 for Us Appliance Operators
by Bill Tynan, W3XO

To Order: **Proceedings - 2003** Minimum donation:
(8½" x 11", 171 pages)

\$20 in the U.S.
\$25 in Canada and Mexico
\$30 elsewhere

Write, telephone or FAX:

AMSAT-NA

850 Sligo Ave. #600
Silver Spring, MD 20910, USA

Tel: 301-589-6062
Fax: 301-608-3410

In US Funds only. MasterCard
or VISA charges are accepted.

Proceedings are mailed postpaid.

ground use, there is no reason that it should not serve as a technology resource for terrestrial use. "Dummy spacecraft" on mountaintops seem a logical development. Some low cost terrestrial hardware is already available.¹⁹ So far, the "Hinternet" activity is based on 802.11x protocols, which in turn are derived from Ethernet; therefore they look a lot like packet radio. They require a timely packet-by-packet acknowledgement in order to achieve a good data throughput. These protocols look very different from a satellite link with light-travel-time limitations. So, while terrestrial and satellite applications might share a lot of hardware, they will probably require different software. But after all, that's not a serious limitation – there is an old adage:

It's only Software!
It's the Hardware that's Hard.

Conclusion

In this paper I have tried to present the radical idea – the Amateur Satellite folks need to lead the rest of Amateur Radio in the preservation of a valuable resource – our microwave spectrum. We have already seen our 2.4 GHz turn into a "sewer" as unlicensed users move in to grab spectrum for their needs. Unless we begin a program to preserve our resources at C-band, they too will fall under the guillotine of consumer technology.

Let's not sing the blues²⁰ "Might not be comin' back at all" to our precious

microwave allocations. Let's carry through on the upbeat note "Just might find me that good girl, and everything would be alright".

Footnotes:

1. Thanks to Paul Rinaldo, W4RI, for supplying an early version of this table.
2. One exception: some S-band amateur TV repeaters have had some success in making life quite unpleasant for WiFi and BlueTooth users although this was not the intent of their activities.
3. See <http://www.arrl.org/hsmm>
4. See <http://www.arrl.org/tis/info/pdf/0304028.pdf>



5. In point of fact, even the unlicensed users are starting to feel the pollution of the microwave spectrum. One (unconfirmed) report I have heard – in a small city in the Pacific Northwest, a wireless LAN installed a few years ago has become useless; the proliferation of unlicensed devices has raised the background noise level by some 67 dB!
6. See <http://www.cisco.com/univercd/cc/td/doc/product/wireless/airo1200/accsspts/ap120scg/bkscgaxa.htm>
7. WiFi channels are 5 MHz wide and are defined as Channel ## = (frequency-5000)/5
8. In the USA, 802.11a also uses Channels 34-66 in the 5170-5330MHz range.
9. See http://www.wi-fialliance.org/OpenSection/pr/pr_pdf/Wi-Fi_Fall_01_Briefing.pdf
10. The song “**CC Rider**” (sometimes called **See See Rider**) was one of more than 100 songs written by the great jazz/blues singer, Ma Rainey (<http://www.redhotjazz.com/rainey.html>) in 1925. In addition to Ma, it was made famous in versions by Mississippi John Hurt, Big Bill Broonzy, Ray Charles, Bruce Springsteen, Elvis Presley, Ian & Sylvia and even the Kingston Trio. I take the blame of picking it as a name for this project!
11. Actually, OSCAR-III in 1965 carried a 50 kHz wide 2 Meter in-band transponder with a 145.9 MHz uplink and 144.1 MHz downlink.
12. Contrast this with a conventional 2 meter repeater which requires a “Q” $\approx [146/0.6] = 243$, a technical challenge ≈ 7.5 times harder.
13. Instead of having Doppler effect the frequency, the entire passband “slides”, much like the Passband tuning on an HF radio. Thus stations near the passband edges may “fall off the edge” as the satellite goes from “away” to “towards” as it moves in the orbit.
14. I used an Excel spreadsheet template provided by Jan King, W3GEY for LEO mission planning.
15. Also by Jan King, W3GEY, designed for the evaluation of the “KarnSat” digital payload for Eagle.
16. The uplink signal is demodulated at the spacecraft, applying the gain of error correction. The “clean” signal then the signal remodulates the downlink. This provides for a significant improvement in end-to-end sensitivity
17. Some very interesting, low-cost, 1/2 watt 5.8 GHz amplifier chips costing < \$10 are available from Hittite: http://www.hittite.com/product_info/product_specs/amplifiers/hmc408lp3.pdf

(thanks to Grant, G8UBN for the pointer).

18. Of course, the antenna might be a phased array instead of a dish following the ideas in Figure 4.
19. Off-the-shelf 1/2 watt C-band amplifiers (intended for terrestrial WLAN use) are available at http://www.hyperlinktech.com/web/amplifiers_5800.html
20. One version of Ma Rainey’s CC Rider goes something like this. Note the highlighted lines:

CC RIDER

Well now see, C.C. Rider
Well now see, see what you have done
Well now see, C.C. Rider
Well now see, see what you have done
Well you made me love you woman
Now your man has come

So I’m goin’ away now baby
And I won’t be back till fall
I’m goin’ away now baby
And I won’t be back till fall
Just might find me a good girl
Might not be comin’ back at all

Well now see, C.C. Rider
See now the moon is shining bright
Well now see, C.C. Rider
See now the moon is shining bright
Just might find me that good girl
And everything would be alright



Editor’s Note:

This article was originally presented at the 2003 AMSAT Symposium and published in the proceedings. Some of the text is dated due to the time delay but is still of interest to the AMSAT community.

Sats are Simple!

Diane Bruce, VA3DB, (AMSAT Area Coordinator)

Amateur radio operators seem to have the idea that working the ham radio satellites is incredibly hard and expensive, not to mention needing a lot of power. It is true that one can have a tower, an AZ/EL rotor, an amazingly complex multi-mode vhf/uhf radio, but it is also true that most people could work the FM birds with nothing more than their handheld radio and a small beam. You can likely get started on the amateur satellites with the station you already have.

Your antenna is an important link in any satellite operator’s setup whether you are just beginning or have been on the satellites for a while. The classic commercial beam for this is the 146/437-10W made by Arrow antenna (<http://www.arrowantennas.com>). This beam combines

3 elements on 2 m with 7 elements on 436 MHz. This beam is used by many amateurs to work the FM birds, AO-27 and SO-50.

If you are on a budget, you can combine designs by Kent Britain, WA5VJB, and Howard Long, G6LVB. Kent’s antenna designs can be seen on-line at: (<http://www.clarc.org/Articles/uhf.htm>). Howard’s home brew arrow antenna design is on-line at:

(<http://www.g6lvb.com/HomebrewArrow.htm>).

Because the FM birds are in low earth orbit (LEO), you can even work them with your current V/UHF mobile radio and a 1/4-wave whip on the car’s roof. You want signals to radiate straight up, which a 1/4-wave will do. The 5/8-wave antenna concentrates its pattern on the horizon, making it less desirable for mobile satellite operations.

Multi-mode HF combined with uhf/vhf radios are now very popular as well. It does not take much extra work at all to get on some of the low earth orbit “linear mode” birds such as FO-29. A simple “clarc” combination beam mounted on a camera tripod combined with a multi-mode radio is all that is necessary. Jerry, K5OE/VK8OE, has a great article showing how to convert a pair of Cushcraft beams into a simple but effective tripod beam that can get you on the LEO linear birds. See: <http://members.aol.com/k5oe>.

It is helpful to know when to listen and where to point your antenna skyward. There are several tracking programs for your PC or Mac. Some are free and others cost \$50-\$75. A free satellite tracking program, SatScape, for the PC can be downloaded from: <http://www.satscape.co.uk/>.

Even easier, you can get short-term Amateur Radio satellite predictions from the Web. Check out: <http://www.heavens-above.com> Hint: Enter your QTH info first, registration is not necessary, then bookmark the final page. Every time you select heavens-above from your bookmarks your custom page for your QTH comes up! Once you’re in, select the “radio amateur satellites” link for a table that shows when all “hear-able” satellites will be within range of your QTH. It even tells you which frequency to listen on.

The Amateur Radio Satellite Corporation, or AMSAT, provides lots of resources on their web pages. See: <http://www.amsat.org>. The latest amateur satellite status, including frequencies, is available at: <http://www.amsat.org/amsat/news/wsr.html>. While you are surfing around at AMSAT, check out: http://www.amsat.org/amsat/features/echo_dayton04/index.html Echo has been launched and can now be easily heard on your handheld radio.

It’s not rocket science, it’s just radio. And it’s a lot of fun. Come on up and join us.



OUR AMSAT-NA DONORS

by Mal Preston, NP2L

Wow! What a year. We all owe our congratulations to all of us who helped make this the best year yet by showing our financial support of AMSAT. The total cash contributions and commitments for our "fund raising year" from June 1, 2003 to May 31, 2004 was a whopping \$160,500. This is in addition to our dues. It reflects a 76% increase in dollars and a 54% increase in the number of contributors. A substantial amount of this comes from our President's Club, which has grown from 90 to almost 200. I guess we really want to see those new birds up there.

This list doesn't include those who have contributed time and equipment. There are many. I'd like to acknowledge one of them in particular. Bob Carpenter, W3OTC, has been maintaining our member and donor database for the last 10 years. He also assists Martha with her computer needs. If AMSAT had contracted to have this done it would be valued at many thousands of dollars. Bob willingly and cheerfully provides the data I need to compile this list and sends it to me almost by return email. Bob is representative of the wonderful volunteer spirit of AMSAT. Thank all these folks like Bob when you can.

Many of the donations on this list have been designated for specific purposes. As always be assured that we scrupulously adhere to your wishes. If we have erred in preparation of this list please accept our apology and tell us about it. Donors contributing \$100 or more are shown in **bold** typeface and President's Club members as PG (gold), PS (silver), PB (bronze) and PC (core).

If you would like to consider joining the President's Club use the handy form on page 6 of this edition of the *Journal* or call Martha at headquarters.

AA1SZ	PC	DALE LANG
AA1WI		BRIAN DORVAL
K1DS		RICHARD ROSEN
K1LKR		RICHARD STEEGSTRA
K1PDY		RONALD T. HERMAN
K1SC		SANFORD COLE, JR
K1WW	PC	RAY CRITES
K1YPZ		RAY WEBB
KA1DF		GEORGE B. PEARSE
KA1IU	PC	MORTON COHAN
KA1MWG		PAUL LECLAIR
KA1SAW	PB	NEAL SWENOR
KA1TAO	PC	LARRY OCHS
KB1EB		JOHN ANTES
KB1GYI		SALVINU C. VELLA
KD1LY		WILLIAM MILLARD
KM1P		JOE FITZGERALD
KN1O		ALAN AMOS, JR.
KR1ZAN		FRANK KRIZAN
KS1G		STEPHAN GREENE
KV1F		UVE LAMMERS
N1AEW		ERNIE BAUER
N1AK		ALEXANDER KUHN
N1AXB		LARRY PIGNOLET
N1BHX	PC	DAVID MACCARN
N1FZX	PC	NATHANIAL STEIN

N1HOQ	PC	SHAWN REED
N1JDU		RICHARD AMIRAULT
N1JFU		STEPHEN MEUSE
N1JS		JOE SANTANGELO
N1NG		MIKE MAXSON
N1NLR		MARK GREENLAW
N1ORC		ARTHUR ROWE
N1RL		RICK LINDQUIST
N1TV		EDWARD S. CRAIG
N1UW	PC	FRANK KANAUSKAS
NB1Z		FRANK G. PARKS
W1AD		FRANCIS D'AURIA
W1CGT		FOSTER NYE
W1COL	PS	FRANK MROZ
W1CWH		RICHARD ROLLER
W1DEY		L. THOMAS DWELLEY
W1FIS		ROBERT SANFORD
W1GUD		WARREN C ELLY
W1GUO	PC	WARREN ELLY
W1GYD		JOHN J. BUBBERS
W1JR		JOE REISERT, JR
W1ME		GEORGE CASWELL
W1NHS		FRED W. RING
W1OTH	PC	RAMON D FOBES
W1PUV		ALEXANDER KULCHUK
W1BAR		ERROLL DRINKWATER
W1DMV	PC	BILL POLEWARCZYK
W1ECF		J.S. LAINE
W1FXK		DONALD PATTERSON
W1QXR	PS	KEN CHAFFEE
WB1BRE		WILLIAM BURDEN
WB1EEB		EARL EMERICK
WB1EEU		FRANK RIDOLFO
WB1FXX		FRANCIS GERACI
WB1GNL		ALEX GISH, III
W1I		BERNARD QUARTAROLI
WX1CT		PHILIP BERKOWITZ
AA2BN		JOHN A. ZARUBA, JR
AA2TX	PG	ANTHONY MONTEIRO
AB2KV	PS	CLIFFORD MAJOR
K2EIA		LEO H. VOELKLE
K2IYQ	PB	STEVE TODD (SK)
K2JET		STEVE KLAVER
K2JNS		JOHN ZAHRADNIK
K2KLV		NORMAN BERNSTEIN
K2LHZ		JOHN SPITZER
K2NV		ANTHONY BUSCAGLIA
K2PEY		JOE HUIE
K2SZ		JIM DICSO
K2UYH		DR. ALLEN KATZ
K2VPR		JOHN TYBURSKI
KA2ENE		HARRY HOFFMAN
KA2TPK		PETER HARDING
KA2UPW		DOUGLAS QUAGLIANA
KB2AYU		ALAN ARRISON
KB2BYW		ROBERT DECLUE
KB2EF		ROBERT CHRISTIANSEN
KB2EZV		FRANK MURATORE
KB2NPT		PAUL BEGIN
KB2NSX	PB	KEVIN HERRON
KB2RC		BILL BRUNO
KB2YOX		GARY STANDORF
KC2FUZ	PC	MICHAEL LAVIN
KC2HDC		FRANK P. SANSONE
KC2KQP		ROGER FOUCHONG
KC2RLM		RALPH MILNES
KC2TN	PC	JOE FISHER
KC3AN	PC	RICHARD HAXTON
KD2Q		GARY R. LONG
KE2MF		RONALD BOOKBINDER
KV2Z	PC	JIM ENTERLINE
N2AJK	PC	PETER SITTER
N2BAL		JAMES B. SHANNON
N2EA		JAMES JARVIS
N2GJ		GERALD JURRENS
N2LDR		MARTIN MILLER
N2PKW	PS	CHARLES HARDT
N2SPI	PG	RICHARD CROW
N2UK		KEN GALLAGHER
N2UN		ANTHONY F. JAPHA
N2VI		ERIC GROSSE
N2WWD		KENNETH ERNANDES
NB2F		DOMINICK
NP2L	PG	INTERDONATO
NP2W		MALCOLM PRESTON
W2CIY		B.J. MCDONNELL
W2DBA		WALTER CREUZ
W2DHT		DONALD B. ANDERSON
W2DTA		WILLIAM PATMOS
W2FS	PB	JOHN HANSEN

W2GFF		R.J. PEACOCK
W2GPS	PG	RICK HAMBLY
W2IIC		JAMES HEPBURN
W2KQ		JOE DREIFUSS
W2LNX	PG	DAVID BERN
W2NBJ		ALEXANDER RICCIO
W2NE		W.E. MODIN
W2WGL		CHARLES PANKIEWICZ
W2XB		DON BLACHURA
W2XI		ANTHONY CHIPALOSKI
W2YTO		H.C. KNIEF
WA2KDL		CHRISTOPHER WACHS
WA2LXE		PHIL BARBER
WA2NYM		JIM CORCORAN
WA2VUJ		DAVID E. WEINREICH
WB2BWL		SAMUEL DEDONATIS
WB2LLP		EUGENE MARKS
WB2QCJ	PS	DEAN KEYSER
WB2RRF		RAY NOLTE
WB2ZZB		HANS NAFTEL
WI2T		JEFF EMBRY
WI2W		STEVEN GLEN HOLLY
WV2U		PAUL HELOSKE
K3FMQ		BILL BALLANTINE
K3HPA	PB	STEPHEN TURNER
K3KN	PC	JOSEPH ROMANOSKY
K3NMF		CHARLES PENNINGTON
K3PER		JOHN PINKHAM
K3SZH		JOSEF SPANDLER
K3TC		TOM CALOMIRIS
K3TNM	PB	BILL BENNETT
K3TZ		TIMOTHY ZIBRAT
K3VDB		CHARLES HEISLER
K3VN		AL HERNANDEZ
KA3HDO		FRANK BAUER
KA3HPQ		WILLIAM M DAVIS
KA3PCX		RAY JACOBS
KA3QKV		T. LEWANDOWSKI
KA3WUJ		DARRYL HAMBLY
KB3DHC		ALAN W STUMPF
KB3FWZ		ALAN B STROM
KB3GI		ALEXANDER HANSKEN
KB3HMO		STEVEN J DIDUCH
KB3JQA		GLENN BOSSLER
KB3KJ		JAMES C. MANKIN
KB5GA		DELOS RAY
N3ASA		SCOTT STEVENS
N3DRR		JOHN PARKER, JR
N3ES		EARL SKELTON
N3ESS		RAYMOND E PAISLEY
N3GJX		ED NOWICKI
N3HKQ	PC	KEVIN J SMITH
N3KS		KAMAL SIRAGELDIN
N3MVF		GREGORY DOBER
N3RZN	PG	GILBERT MACKALL
N3TYD	PB	AL WILLIAMS
N3UD/VE3N		PAUL
N3UNM	PC	TABATSKOW
N3WF		EDWARD STEPP
N3XM		MIKE FONTENOT
N3YBE	PC	TOM MITCHELL
N3YDT		PERRY SIDWELL
NM3A		JAMES RANDALL
W3ABC		DANIEL WALTER
W3ASK	PC	HUGH TURNBULL
W3BPB		GEO JACOBS
W3BW		JON A. GERBRACHT
W3DQ		BRIAN WRUBLE
W3EZ	PG	ERIC ROSENBERG
W3FB		W.R. JACKSON JR
W3FUO		WILLIAM J. EVANS
W3GXT		HUGH B. O'DONNELL
W3GYK		LESTER L. MCCLURE
W3GZZ		WAYNE ACKERMAN
W3HMS		LYNNETTE K EVANS
W3HQX		JOHN JAMINET
W3ICM		PERRY F. CRABILL, JR
W3IWI	PG	FRED MATOS
W3LUI		DR. TOM CLARK
W3MMV		IRVING SHEPPERD
W3NPS		FRED LOWE
W3PRB	PB	TERRY GOOD
W3QO	PC	JOHN TOWNSEND
W3STW		ALLEN MOORE JR
W3TFA		ALFRED TRIBBLE
W3UJG		STAN BRIGHAM
W3XO	PG	ERNEST WHITE
W3YOZ		BILL TYNAN
WA3AEF		MARTIN JOHNSON
WA3BDV		JOHN ZONDLO
		THOMAS HUFNELL



WA3EOQ		HOWARD REYNOLDS	W4PUJ		RICHARD L. DANIELS	W5BJV		MARCEL PITZINI
WA3GFY		DAVID KOSMIN	W4PZA		DR. ROBERT ROY	W5DID	PB	LOU MCFADIN
WA3HVQ		GEORGE J. HERPICH	W4RI		PAUL RINALDO	W5DTR		CURTIS R. WILLIAMS
WA3JAT		JAMES BERRY	W4SCO		LESLIE SCOFIELD	W5GFP		GEORGE PIERCE, III
WA3WOD		DONALD B. SYLVAIN	W4SM	PG	STACEY MILLS	W5GN		BARRY MERRILL
WA3YER		DAVID CROYLE	W4TIJ		MILO MOUCHA	W5IU	PC	KEITH D. PUGH
WA3YWC	PC	LOUIS DOD	W4TZG		RAY BURNS	W5LQD	PS	HERMAN MIDDLETON
WB3FQY		J.E. "YOGI" BEAR	W4WJ		DON MURRAY	W5PGZ		WILLIAM GRAVETT
WB3JFS		JEFF YANKO	W4ZJN		JOHN W MCCORMICK	W5SRP		KEN WENDEL
WP3GW		ANGEL SANTANA	W4ZY		ROBERT SCOTT	W5TFY		ROBERT D. BAILEY
WP3K		MICHAEL BLAIR	W4ADG		CARL LYSER	W5VZF	PG	JIM AKERS
WW3O		PETER CARR	W4ABQM		KERRY KINGHAM	W5XT	PB	E.E. ROBINSON
AA4MD		JAMES HUHTA	W4ACMU		DAN NEWMAN	W5ZA		STEVEN BIENVENU
AA4RC	PC	ROBIN CUTSHAW	W4KFZ		MARK BRAUNSTEIN	WA5QGD		RAYMOND HOAD
AB4HE		FRANK FRETTER	W4MCA		GUSTAVO DIAZ	WB5AAA	PC	JAMES BARRON
		WHITE	W44SCA	PG	ALAN BIDDLE	WB5LLI		MICHAEL SALADINO
AC4QO		ROBERT SCOTT	W4SWJ		EDWARD ALYN LONG	WB5TPR	PC	GERALD KRAUSE
AF4JJ		TOM BASKIN	W44SXM	PC	G. GOULD SMITH	WD5GLD	PS	RICHARD RUHL
AF4VE		PHILIP JANSEN	W44VKW		KIM A. HINCEMAN	WQ5C		MICHAEL PFEUFFER
AG4SO		STEVE BLANKINSHIP	W44VZW		BRIAN E. GAFFNEY	WQ5N		STEVE DAKIN
K4CSO		CHARLES S. OSBORNE	W44WDL		JOHN FRANKE	AA6W	PC	DON ANASTASIA
K4DXA		KENNETH W. BOYD	W44YMZ		GARY ROGERS	AB6VU		AUSTIN LESEA
K4OZS	PC	LARRY PHELPS	WB4APR		BOB BRUNINGA	AH6EZ	PC	RICHARD ILLMAN
K4PCB		KEVIN BRACKINS	WB4AZG		KEVIN MASIULIS	K6AWO		BILL DEWS
K4UJA		DAVID KENT	WB4FNN		SCOTT MOORE	K6CCC		JIM WALLS
K4WFP	PG	WAYNE POOLE	WB4FWQ	PC	TOM HUGHES	K6CQR		EDWARD C. GESSERT
K4YAZ		TOM COPLEY	WB4GCS		JAMES SANFORD	K6CUY		LEONARD GOFF
KA4HPB		JOSEPH L. REDA	WB4GLJ	PC	JOHN WINGARD	K6DUX		IRV ASTMANN
KC4YHI		KATHY HITT	WB4LHD		RANDY WILDER	K6ELQ		ANTHONY J. SLUPKO
KC4YMB		E. THOMAS HITT, III	WB4OBO	PC	JOHN JOHNSON	K6IXF	PB	BARRY LANDSON
KC4YMR	PC	JOHN BROOKS	WB4QKQ		LAKEY TOLBERT	K6PW1		MERRICK CREAGH, III
KD4APP		DON WOODWARD	WB4SMS		LAWRENCE W. STEIN	K6QXB	PS	HERB SULLIVAN
KD4FRB		WILLIAM RAFUS	WB4YDL	PB	JAMES HALL MD	K6TXD		GERALD HORN
KD4GZK		ELMER LOCKE	WB4ZMP		JOSEPH MORRIS	K6UI		W.R. ADEY
KD4KL		MICHAEL TERRY	WD4ASW	PG	BARRY BAINES	K6US		STEVEN SHARP
KD4NOQ		DAVID CAMPBELL	WD4KSS	PC	JAMES NEAL PRUITT	K6UX		STEVE EGERT
KE4RFT		THOMAS LEWIS	WS4Z	PC	ANNA OSBORN	K6UXO		KENNETH KERWIN, II
KF4BWQ		GREG PRESTON	WU4W	PC	HILARY OSBORN	K6VV		ASA COLLINS
KF4CUP		DOMINGO TRUEBA	AA5ZZ		ROBERT BOUCHER	KA6IAR		WILLIAM
KF4JEX	PG	CHARLES RUSHING	AD5KZ		ROY RABEY	KC6ROL	PC	BITTENBENDER
KF4OD		JIM NAGLE	AD5L		HAL MILES	KD6AKC		WILL MARCHANT
KF4OTN		ERIC CHRISTENSEN	AE5GH		GERALD HOGUE	KD6FJI		MARK LINDSEY
KF4XB	PC	KEN PIERPONT	K5EDM	PC	IAN PATERSON	KD6IRE		LLOYD DEVAUGHNS
KG4EMO		GEORGE CANNON	K5ENG		CHARLIE KENG	KD6NA		DON FERGUSON
		JACOB ERICH	K5GM	PC	PETER JORDAHL	KD6PAH		JIM SHANK
		JENNINGS	K5HV	PC	H.N. VORDENBAUM	KD6UO		JOHN HOPPRICH
KG4OJS		HOWARD E JACKSON	K5IS		JEROME DOERRIE	KD6VW		ROGER STRAUCH
KG4PBI		JAMES D HARRISON	K5JWL		JACK W. LESTER, JR	KD6V		CHUCK KINKEY
KG4QWC		JAMES A. DEYOUNG	K5LKM		GARY AVERY	KD6WLE	PB	HAROLD WILLIAMS
KG4YJR		DAVID J HETTRICK	K5LLL	PG	RON MAROSKO	KE6AIF	PC	SIEGFRIED JANSON
KI4EHA		RAFAEL COLEDON	K5MAN	PC	KARL SANDSTROM	KE6YEX		GREG SHREVE
KJ4G		PAUL EAKIN	K5NRK	PB	RUSS TILLMAN	KF6VQZ	PS	MORGAN TAYLOR
KL4E		CRAIG BLEDSOE	K5OE	PC	JERRY BROWN	KG6BQ	PB	ELMER WINTERS
KM4ML	PC	RICHARD RUCKER	K5PER	PS	JAMES L. JONES	KG6QMO		EUGENE SAVAGE
KM4FE		MARTY KOEFOED	K5RCR	PC	RICK ROGERS	KG6RHE		GERRY E. ROLLE
KN4ST	PC	ELWOOD MILES	K5SWA		GERALD BRADLEY	KI6OS	PS	GERALD STOKER
KO4MA	PC	ANDREW	K5UIC	PC	THOMAS BROWN	KJ6HZ		JOHN OPPEN
		GLASBRENNER	K5VAS		PAUL STONESTREET	KO6E	PC	MERV HECHT
KO4MH		BILL KUHN	KA5Z		RICHARD JONES	KO6YO		DENNIS GHATIS
KP4EO		FELIX MISCALICHI	KB5MU		PAUL WILLIAMSON	KQ6EA	PC	JIM JERZYCKE
KS4WX		HANK JENKINS	KC5DLU		JIM MARKWELL	N6IFU	PC	BYRON FOSTER
KX4Y	PC	DIETER K.	KC5IIO		ROBERT LOHRE	N6IK		DR. RICHARD J.
		SCHLIEMANN	KC5MLC		GARY HOLLOWEL	N6MN		SHERMAN
N4DZP		WILLIAM ROMIG	KC5UYR		DAVID FORBES	N6OR		WILLIAM J. MCNALLY
N4EN		GREGORY BOWMAN	KC5WBV	PC	GEORGE HUMPHREY	N6OU		KEITH SCHAFFRATH
N4HY	PB	BOB MCGWIER	KD5AAY		PATRICK KARP	N6PA		EDGAR BROWN
N4ION		NEIL TAYLOR	KD5HIP		JOHN D ZUMBRO	N6SF		RONALD MILES
N4LC		KENNETH LEINER	KD5JSH		ARTIE L BIBLE	N6TE	PB	MARK GANG
N4LT	PC	RICHARD WILSON	KD5MHC	PG	CHARLES GUNTER	N6TQS		HARRY BLUESTEIN
N4QQ		JOHN SHEW	KD5NJR	PC	SCOTT HALEY	N6ZUC		DOUG FAUNT
W4AD		JOHN O'MARA	KD5NNN		ANDREW J WATSON	NN6RF	PC	LOW
W4ART		ARTHUR FELLER	KD5TIO		THOMAS M CAMPBELL	W6AHD	PS	DON STIVER
W4AT	PC	CHARLES HENNESSEY	KD5WBI		GARY CILENTO	W6ART		CHARLES C RUBEY
W4AWI		RAUL PLA	KF5B		DUANE B PERKINS	W6CPA	PC	GLEN AKINS
W4CJ		CHAD JOHNSON	KF5QT		JAMES PUMPHREY	W6E1	PB	KEN CHAFIN
W4CMB		BILL RICH	KI5AB		STERLING MCBRIDE	W6EJJ	PC	ROBT IANNUCCI
W4DGE	PC	DANIEL MCMILLIN	KS5Z		GARY "JOE" MAYFIELD	W6EKK		JAY HOLLADAY
W4EAT	PC	CARL STARNES	KZ5RW		ROBERT WITTNER	W6ETK	PC	STAN JOHNSON
W4EPI	PC	STEPHEN DIGGS	N5AFV		ALLEN MATTIS	W6IHG		NORRIS NAHMAN
W4HFZ		CHARLES RICHARD	N5AYD		JOHN REYNOLDS	W6KJ		JERRY PIXTON
W4HJZ		CARL A. EBHARDT	N5CSU		RICH CASEY	W6OYJ		RONALD MURDOCK
W4JBB	PC	JOEL BLACK	N5DF		JOHN STENSBY	W6RYO		R.E. MUNN
W4KWH	PB	KEVIN HERRON	N5GO		JOHN PAUL	W6RZ	PC	GARY GONNELLA
W4LNA		MIKE MURPHREE	N5JOA		JOSEPH FUGITT	W6WYQ		RON ECONOMOS
W4MO		S.E. HAAG	N5LBJ		DOUGLAS KEARNEY	W6XD	PC	WALLACE ENGLISH
W4MSZ		WILLIAM BUTCHER	N5RRL	PC	BOB MOESER	W6XS	PC	ART GODDARD
W4MVB		JESSE MORRIS	N5SJS		DAVID G LEWIS	W6YEP	PC	BOB MCNAIR
W4NLT		MICHAEL A.	N5VYW		GEORGE S SWAN	WA6CFM		PATRICK FENNACY
		KUBISHEN	N5VVF		MIKE DONELSON	WA6DSK		RICHARD DOERING
W4OWA		R.W. RUEDISUELI	N5ZNL		RICK LARGENT	WA6FDI	PG	JAMES MARSHALL
W4PID		ROY O. HILL, JR	W5ACM	PC	ANDY MACALLISTER			ART WHELAN



WA6FWF	PG	KEVIN SCHUCHMANN	KB8LEF		JOSEPH SENGER	KA9VGG	MOZES SZABO
WA6ICW		DONALD LUM	KB8ZJH		ROBERT WITTMUSS	KA9ZIM	DANIEL GACEK
WA6ILT		DAVID REINHART	KC8OKB	PC	JOHN D BOTTI	KB9PIE	JOHN T. BELL
WA6JYU		JACK TROUP	KC8OTI		ALLEN ALTER	KB9UJL	JOE ANDERSON
WA6PAC		CHESTER RICE	KC8PLY		MIKE AULDS	KB9VMW	THOMAS DENTON
WA6PBG	PS	JERRY STOKER	KC8RAN		JOE PROKOP	KB9WCA	CARL PETERSON
WA6RNU		STAN REUBENSTEIN	KE8FK		EDWARD R. LOCK	KB9WEK	MIKE SEHNER
WB6GVV		LEE WONG	KE8RG		JOHN DECKER	KB9YVG	BEN BERNSTEIN
WB6QVU		KITCHELL BROWN	KI8G		JAMES BURDICK	N9DR	DOUGLAS ROSE
WB6TIK	PC	HOWARD ANDERSON	KR8L		WILLIAM PARMLEY	N9GF	AUGUST E. FIEBIG, JR
AA7RV		KENNETH WEEK, JR	KW8KW		WILLIAM J. O'NEIL, JR	N9HF	DAVID KERL
AC7R		G. HINTON	N8AAY		GARY WIDMAYER	N9HR	TOM WRENSCH
AC7YY	PC	KIM AIKEN	N8BMA		DAVE WANG	N9HRE	JAMES SPAIDE
AL7CR		DEAN SHUTT	N8CBW		CLARK WIERDA	N9IP	STEPHEN BELTER
K7ASU		TERRY HOFFART	N8DEU	PS	TIM CUNNINGHAM	N9IWW	KEVIN ADAM
K7EG		JIM DENNENY	N8EQJ		EDWARD POLACK	N9KLM	MICHAEL BLAKE
K7MT		BILL ERHARDT	N8FGV	PC	DANIEL SCHULTZ	N9ML	BUD SMALL
K7RJ		RON JONES	N8GUS	PC	RON LONG	N9NJY	MARCEL BECHTOLDT
K7RR	PS	CLIFF BUTTSCHARDT	N8GZL		JENNIFER ROJOWSKI	N9RIN	CHRISTIAN SHOAF
K7VJP		EDWARD C FOY	N8IGJ	PC	ARMANDO MERCADO	N9RPU	LLOYD VANDERVORT
K7XF	PC	RICHARD HENRY	N8KW		MARC HOLDWICK	N9SR	STEPHEN
K7XT		GARY NARRAMORE	N8LGE		CHARLES		RENTMEESTERS
K7YDL		GREG LAHAIE			FITZSIMMONS	N9WYO	GLEN OGLE
KA7EXM	PC	ROGER HAYWARD	N8NRE		STEVEN SCHOEMANN	N9ZKS	NORMAN I HUBER
KB7ADL		VINCENT FISCUS	N8NUY		EDWARD COLLINS	NA2X	ROBERT ROSSI
KB7WUK		MICHAEL A. HEMEL	N8OCX		BROOK D. SMITH	NA4SA	STEVEN SCHINDLER
KC7JRU		SAMUEL LYNCH	N8OZB		RICHARD MARKER	W1WXS	LEANNE BRADLEY
KC7KOH		WAYNE CROUCH	N8QGC		JOHN SHEETS	NA9D	JONATHAN OGDEN
KC7NEB		DAVID C. THOMAS	N8QOD		JOSEPH MUCHNIJ	W9AE	WAYNE ESTES
KD7HGL		JOSH LOGAN	N8RQM		JOHN SMART	W9CBS	RAYMOND F. KAAS
KD7OTV	PC	DAVID CROMER	N8SAZ	PC	SAM POWELL	W9DQ	PHILLIP CRAWFORD
KD7RCJ		JACK LUNSFORD	N8UR		JOHN ACKERMANN	W9FBC	MAURICE J. MEAD
KD7SEE	PB	JOHN ALLEN	N8XD		KEITH DELONG	W9FK	WEST ALLIS RADIO
KE0AZ	PC	DAVID BRUNNER	N8XKZ		MICHAEL RADWICK		AMATEUR
KE2IV	PS	GEORGE SCHNEPF	N8ZT		CRAIG D. KOLLAI	W9FOZ	ROBERT FLINN
KE7VZ	PC	HARRY SEARALES	N9AB		ANDY BACHLER	W9FRU	ROBERT BLANEY
KK7KX		ASSI FRIEDMAN	NE8L	PC	LLOYD ELLSWORTH	W9FY	OLAF NURMEPUU
KK7SZ	PS	HAROLD JOHNSON	W8AAS		DAVE TAYLOR	W9GB	GREGORY BEAT
KL7AR		MIKE SWELEY	W8ABZ		DALE E. REED	W9JF	JAY FINN
KL7XJ	PC	DALE HERSHBERGER	W8BXV	PB	ALBERT KRIEGER	W9JUV	JOE SCHROEDER
KR7AC	PS	HAROLD JOHNSON	W8DVI		FRANK MAGYAR	W9NTP	DON MILLER
N7AAM		JOHN MALONEY	W8EH		ERNEST HOWARD	W9OFZ	G.H. KUETHER
N7AR		ARTHUR READE	W8GSM	PG	GUNTHER MEISSE	W9QN	THOMAS TROIKE
N7BFS		DOUG COLE	W8GUS		RONALD LONG	W9REG	TIPPECANOE A.R.A.
N7BRJ		GARY MEMORY	W8IDM		DONALD PEARSON	W9VEQ	JAMES BROWN
N7DCS	PC	GIL BRENTLEY	W8IJ		DAVID BARROWS	W9WDN	JOE GLICKAUF
N7DRB		JIM O'LEARY	W8MRR		JAMES H. JIPPING	W9XA	KERMIT CARLSON
N7EM		RON SEFTON	W8PNB		ARTHUR J. DISHER, JR	WA9AFM/5	THOMAS WEBB
N7EQF	PC	ALBERT OZIAS	WA8CBA	PC	ROBERT BIGGS	WA9BLA	KENNETH COURTNEY
N7OLS		BILL STILES	WA8FKC		ANDREW SZUCS	WA9BST	DAVID LIEB
N7UB	PB	ALBERT ZOLLER	WB8COX		TOM BRAY	WA9KXZ	GERALD MIGELY
NN7K		JIM FOSTER	WB8IMY		STEVE FORD	WA9PZL	ROGER P. LEY
W7BUN		JERRY SELIGMAN	WB8KKZ		MARK R. SMITH	WB9ANQ	BRUCE RAHN
W7CNC	PC	LESTER WHITAKER	WB8LEM		MARK LEVAUGHN	WB9JEJ	JOANNE MAENPAA
W7DU		CARROLL SWAIN	WB8OOJ		SCOTT SHAHEEN	WB9NEY	GERALD A. JONES
W7ER		CLIFF BRUCE	WB8OUE		TOM CAIN	WB9PNU	JOHN GERMANOS
W7JYJ		LAURENCE LAITINEN	WB8SBI		JAY SCHWARTZ	WB9SMM	JOHN LEEKLEY
W7KBM		KEN OLIVER	WB8WLD		STEVEN COLLIER	W19WI	JIM FITZPATRICK
W7KKE		KEN SWAGGART	WB8WOR		TOM BUSCH	WJ9F	RUSSELL PLATT, JR.
W7LB	PS	LARRY BROWN	WB8WUP		JOHN BOYD	AE0S	DALE HUFFINGTON
W7LRD		ROBERT JOHNSON	WD8CDP		JIM BROWN	AF0SS	HOWARD ROBB
W7RT		RICHARD TANNEHILL	WD8OJL		PAUL PICKING	K0ALN	ROBERT MERRITT
WA7GCS		LOUIE A. STOBER	AA9GY	PC	PAUL HISE	K0BJ	BRUCE FRAHM
WA7GIE		DAVID WILLIAMS	AC9Z		MARTIN LEIDER	K0BRO	RONALD R. WOOD
WA7QFR	PS	REN RODERICK	AJ9K		DANIEL LITTLE	K0CEH	WALTER L.
WA7ZZB		THEODORE	AJ9P		ROBERT HALBMAN		WITTENBERG
		ANTANAITIS	K9AND		ANDREW SHARKEY	K0CY	BOB MCCAFFREY
WB7CSL	PB	WALT IRELAND	K9ATR		MILTON GIBSON	K0GEO	JAY C CLOSE
WF7S		BILL DALRYMPLE	K9DID		BEN WRIGHT	K0GRM	DENNIS MURPHY
WN7B		THOMAS LUKE	K9DRF		DARHAL J WOLF	K0GS	GEORGE H. SAUM
WX7P		WILSE MORGAN	K9EA		DAN MICHNAY	K0HML	RALPH BOLT
AA8UU		JOHN TEAGARDIN	K9EK		ED KROME	K0IQE	ALVIN GLUSICK
AB8NU	PC	MICHAEL COLARIK	K9HF		PATRICK MARINEAU	K0JQ	JIM QUIGLEY
AB8TT		JOHN STUMPF	K9IJ		JOHN RICE	K0MDJ	MARK JOHNS
AC8W		STAN ARNETT	K9KK	PC	RICK VIDMAR	K0NR	ROBERT WITTE
K8CJ		CHARLES J. BARONE, MD	K9KL		GREGG SEIDL	K0SCC	STEPHEN MEER
		R. GORZYNSKI	K9LDW	PC	LOWELL WHITE	K0VM	ALVIN GROFF
K8DID	PG	JOHN WILLIAMS	K9LF	PG	WILLIAM BROWN	K0VPL	DOUGLAS BESEMER
K8JW		BERNARD W. JOSEPH	K9PO	PC	SCOTT MIGALDI	K0VCN	MONT O'LEARY
K8LIX		GARY GREBUS	K9QHO		MICHAEL WILLIAMS	KA0DQV	FRANK BREWSTER, JR.
K8LT		THOMAS L. MILLER	K9RY		RAYMOND BAKER	KA0SWQ	RICHARD AGNEW
K8PNW		JAMES JAEGER	K9SB	PC	TIM TOMLIANOVICH	KA0TAO	LARRY OCHS
K8RQ		ROBERT HALLEY	K9SM		SCOTT MILLICK	KB0BVR	RANDY GREEN
K8YMI		DANA E. WHITLOW	K9UML	PC	ROBERT WILLETT	KB0EMR	R ECHTERNACHT
K8YUM	PB	JAMES SANFORD	K9WMW		BOB LUDTKE	KB0G	BDAL GARBEE
K8ZZU		MICHAEL P. MURPHY	KA9ERV		WILLIAM C PARHAM	KB0JQO	RYAN BUTLER
KA8ABR		JEFFREY P VAN METER	KA9ETP		EDMUND F GAFFNEY, JR	KB0PSS	STEVEN WIEBKE
KA8HQL		RAYMOND FRITTS			JOHN K. OBER	KC0COU	KEN DURAN
KA8SYX		MALCOLM REYNOLDS, JR	KA9LRE		PHILIP R. KARN, JR	KC0EOE	PHIL MEHALKO
KA8YUM		WESLEY PIERCE	KA9Q		THOMAS J. BUTLER	KC0GPY	ELSA BRUNO
			KA9TVT			KC0JHQ	K MARK CAVIEZEL
KB8DXJ							



Field Ops Update: 2004 AMSAT Highlights at the Dayton Hamvention

Barry A. Baines, WD4ASW, wd4asw@amsat.org

AMSAT enjoyed another outstanding weekend at the Dayton Hamvention. Thanks to the efforts of our cadre of dedicated volunteers who manned the AMSAT booth, made Forum presentations and assisted with setup and takedown of our exhibit, AMSAT had a very strong presence at this year's Hamvention. Highlights included:

- A very successful Echo Launch Fund Campaign that resulted in \$5,450 from 113 donors plus an anonymous donation of \$25,000. As an incentive to contribute, a prize drawing was offered to those who donated a minimum of \$25.00 which consisted of the new Alfa Radio AZ-EL rotor as well as receiving an Echo Launch Fund pin ("I gave Echo a lift"). The lucky winner was E. Rojowski, N8GZL, of Detroit, MI. As this article is being written, AMSAT is now over \$97,000 towards reaching the \$110,000 launch campaign total.
- Once again an AMSAT membership drive was offered for new and renewing memberships at Hamvention. Sam Powell, N8SAZ, of Wilmington, OH is the winner of the S-band downlink and L-band uplink system that was offered as an incentive to join or renew at Dayton.
- The AMSAT Forum on Saturday morning was packed with several hundred attendees. The major areas covered by three presentations were Echo and the future of Amateur Radio in space.
- AMSAT's library of publications was very popular. Gould Smith, WA4SXM, released his latest offering, "Echo: Operation, Development and Specifications", which is written from the operator's perspective for using AMSAT's latest satellite. Mike Seguin, N1JEZ, provided an updated "Amateur Satellite Frequency Guide" that includes the Echo analog and digital frequencies.
- AMSAT demonstrated and offered the latest version of MacDoppler Pro from Dog Park Software that has been designed for MAC OS X and is available at a discount to AMSAT members.
- SCRAP for the Windows Operating System was demonstrated during Hamvention for the first time.
- As in past years, the Arrow Antenna was available at the AMSAT booth. These antennas continue to be very popular

with both existing satellites and the expected launch of Echo. Drew Glasbrenner, KO4MA, and Steve Diggs, W4EPI, conducted satellite demonstrations with AO-27, SO-50, and AO-7 throughout the weekend.

- The AMSAT Friday evening dinner at the Amber Rose Restaurant was well attended.

Hamvention attendance appeared to be down from 2003 levels and overall activity at the AMSAT booth was down somewhat from the prior year. Poor weather on Friday and Saturday kept the commercial area busy in the morning, but the attendance 'lag' was noticeable on Friday afternoon in particular. This may reflect the general trend in hamfests in general. Despite this downturn, Dayton continues to be the premier Amateur Radio show in North America and the Hamvention Committee confirmed that the 2005 Hamvention would be at the Hara Arena.

AMSAT is fortunate to have a cadre of individuals who handle the preparations for Hamvention, deal with booth setup, and work the variety of logistical issues that are part of Hamvention. Arrangements began with obtaining a block of hotel rooms at the Hampton Inn in Fairborn under AMSAT's control that Martha Saragovitz coordinated. Dayton Team Leader Barry Baines, WD4ASW, coordinated booth arrangements with the Hamvention Commercial Exhibit Committee and the Forum Committee on time and location for the AMSAT Forum.

Efforts then began in earnest to provide updated materials at Dayton and to coordinate the myriad of AMSAT activities. Ed Collins, N8NUY, worked with the Amber Rose Restaurant to finalize arrangements for the Friday evening dinner and publicized the dinner on AMSAT-bb. Author Gould Smith, WA4SXM along with Mike Seguin, N1JEZ, were contacted to ask about updating their publications in time for Dayton. A new golf shirt highlighting AMSAT's 35th anniversary along with a T-shirt featuring a 'Pigs in Space' theme were designed by Art Feller, W4ART.

AMSAT is indeed fortunate that Ed Collins, N8NUY, lives in the Dayton area, as he provides an invaluable service by receiving AMSAT materials and placing them in a storage locker rented by AMSAT along with all of the other AMSAT booth materials. Ed also arranged for rental of a truck to transport

our booth equipment along with the books, trinkets, etc. that we offer every year. He also provided a liaison with the Hamvention Committee that resulted, for example, in having our AMSAT dinner information included in the Hamvention Program Guide.

The first wave of volunteers met for breakfast at the Hampton Inn on Thursday, May 13. Robin Haighton, VE3FRH, and Barry Baines, WD4ASW, went to obtain the rental truck and returned to the hotel. They were joined by a group of volunteers that consisted of Art Feller, W4ART, Dave Bern, W2LNX, along with Steve Diggs, W4EPI, and Mal Preston, NP2L who proceeded to the storage locker to collect the booth equipment, boxes of stuff shipped to Dayton, and support materials and place it in the van. The group then proceeded to Hara Arena.

Setup at our usual booth location (445-448) went smoothly on Thursday as additional volunteers (such as Jeff Embry, W12T) arrived to assist with the process. Keith Pugh, W5IU, drove in from Ft. Worth, TX and setup his computer for demonstrating Nova, Instant Trak, and QuikTrak.

Thursday evening was the 'lull before the storm' as Hamvention began the next day. A number of AMSAT members attended a 'Pizza and Suds' informal get together at Marion's Pizza in Beavercreek, OH. Over 40 people attended the function that provided an opportunity to see old friends and meet new acquaintances.

The opening of Hamvention on Friday at 0900 began a three-day marathon of booth activities that required over 120 volunteer hours just to man the booth. Over 28 volunteers spent a portion of their weekend at the booth assisting people who wished to join or renew their memberships, obtain the latest software or publications, pickup the latest in AMSAT 'fashions' (a golf shirt featuring the 35th Anniversary of AMSAT), or donate to the Echo Launch Fund. Meanwhile, Martha Saragovitz and Bob Carpenter, W3OTC coordinated the myriad of charge card activities, handled membership questions, and helped to ensure the smooth operation of the booth.

As in past years, AMSAT President Robin Haighton, VE3FRH, scheduled 'office hours' at the AMSAT booth so that members would have an opportunity to discuss what was on their minds about our organization. By providing specific times for Robin, the President was more accessible to the



membership. When Robin wasn't speaking with a member, he contributed his time by manning the booth and responding to queries from those who needed an item or handling their membership needs.

One of the joys of Hamvention is the opportunity to see old friends and to meet new ones. The annual AMSAT Friday night dinner took place once again at the Amber Rose Restaurant in Old North Dayton. Nancy Makley, KC8GYW, handled advance reservations and maintained the 'head count' for the restaurant. Ed Collins, N8NUY, was available at the AMSAT booth on Friday to take additional reservations and provide directions on how to get to the Amber Rose. Over 75 people attended the dinner. As usual, the Amber Rose did a fine job of providing a well-prepared meal that was moderately priced. The consensus of the attendees was that AMSAT should have their Friday dinner at the Amber Rose next year as well.

The intensity of Hamvention on Saturday was high immediately after opening at 0800 as the AMSAT Forum was scheduled from 0815-1045. Almost immediately after the commercial exhibits opened at 0800, a large crowd gathered in Forum Room 1. Due to the reconfiguration of the Forum rooms, some people had difficulty in locating the meeting room, as the primary means of entry was an outside entrance that was around the building and was located right by the screen and the presenter's podium. Consequently, people got wet while moving from the commercial area to the Forum and had to run the 'gauntlet' by the presenter. Despite these obstacles, the Forum was well attended and everyone enjoyed three outstanding presentations. AMSAT Executive Vice President Rick Hambly, W2GPS, provided updated information on the status of Echo in his talk "AMSAT OSCAR-Echo Project Spring 2004 Status Report." Gould Smith, WA4SXM then provided a well received overview entitled "Echo-From an Operator's Point of View" which was based in part on the new book he wrote for AMSAT ("Echo: Operation, Development and Specifications"). Following the focus on Echo, Frank Bauer, KA3HDO (AMSAT VP-Human Space Flight) shifted gears to discuss "AMSAT's Future Role in Human Spaceflight Exploration-ARISS, the Moon and Mars." Frank first provided both background and the status of Amateur Radio on the International Space Station given the current situation with space shuttle flights not scheduled to take place until 2005. Future shuttle launches will be providing additional Amateur Radio hardware to the ISS. Looking in the future, Frank also

discussed "NASA's Vision for Space Exploration and AMSAT's Future Participation." The ARISS team has already been approached by NASA to develop tentative plans/ideas for the role of Amateur Radio in the Moon/Mars initiative. Frank made it clear that the time to act is now while the interest at NASA is high.

After Frank's presentation, a few minutes were available for Forum attendees to ask questions to the presenters. The Echo Launch Fund was highlighted during Forum, and a number of attendees left a donation at the door as they left the Forum. The collection of 'pocket change' generated over \$240.00 in additional funds for the launch. Also mentioned during Forum were the satellite demonstrations led by Drew Glasbrenner, KO4MA, and Steve Diggs, W4EPI. A number of people were able to take advantage of these demos despite the poor weather conditions on Saturday.

On Sunday, Hamvention was open from 0800-1300. At 1200, AMSAT had its drawing for its Membership Incentive prize which consisted of Mode-L uplink and Mode-S downlink equipment. Sam Powell, N8SAZ, of Wilmington, OH won this prize. The next drawing was for the Alfa Radio Az-El rotor system that was the prize for the Echo Launch Fund. Anyone who donated a minimum of \$25.00 to the Launch Fund during Hamvention was eligible for this prize. E. Rojowski, N8GZL, of Detroit, MI was the lucky winner. Thanks to everyone who has contributed to the Echo Launch Fund.

After the commercial exhibit area was closed at 1300 and while attendees sat in Hara Arena to see if they won any prizes, our volunteers proceeded to dismantle the AMSAT booth, pack boxes for shipment back to Silver Spring and load the truck. In about 90 minutes the entire process was completed, including delivery of boxes to the UPS Store folks who were in the North Hall for shipment back to Silver Spring. By the time that prizes were drawn, the truck was ready to proceed back to the storage locker. The same team that setup on Thursday that now included Jim Sanford, WB4GCS, loaded the truck and returned the materials to the storage locker. The truck was returned to the Budget facility in Fairborn late Sunday afternoon by WD4ASW and WB4GCS and another Hamvention was history.

Certainly one of the highlights for AMSAT at Hamvention was the strong support generated for the Echo Launch Fund. 113 people contributed \$5,450 plus an additional donor contributed \$25,000 that brought AMSAT to over the \$93,000 level

contributed to meet the \$110,000 launch cost. In addition, interest in AMSAT's latest publication written by Gould Smith, WA4SXM, that covers Echo from a satellite operator's perspective was well received. People expressed strong enthusiasm for the upcoming launch of Echo and the forward-looking presentations that were given at the Forum.

Dayton Hamvention continues to be an exciting place for Amateur Radio. AMSAT certainly enhanced the overall scope of Hamvention with an outstanding booth display, a high degree of interest in our Forum, and the opportunity to socialize and exchange ideas. Our success is due primarily to the score of dedicated volunteers who handled setup and takedown, manned the booth during Hamvention, gave presentations at Forums and elsewhere, and represented AMSAT so ably during Hamvention. Thanks also to AMSAT Office Manager Martha Saragovitz who has a keen eye for detail, a willingness to keep the team 'on track' and the ability to deal with the myriad of Hamvention challenges with grace. As always, Dayton Hamvention was both physically demanding and a fun filled weekend coupled with a great sense of teamwork and cooperation that resulted in another success for AMSAT. Thanks!

AMSAT thanks the following individuals for their time/support assisting AMSAT at the 2004 Dayton Hamvention.

Don Agro, VE3VRW, Toronto, ON
Barry Baines, WD4ASW, Concord, NC
Frank Bauer, KA3HDO, Silver Spring, MD
David Bern, W2LNX, Potomac, MD
Tom Busch, WB8WOR, Bloomington, IN
Bob Carpenter, W3OTC, Rockville, MD
Tom Clark, W3IWI, Clarksville, MD
Ed Collins, N8NUY, Dayton, OH
Steve Diggs, W4EPI, Lilburn, GA
Jeff Embry, W12T, Gaithersburg, MD
Art Feller, W4ART, Fairfax, VA
James French, W8ISS, Lincoln Park, MI
Mark Gang, N6SF, Woodside, CA
Drew Glasbrenner, KO4MA, New Port Richey, FL
Guillermo Guerra, XQ3SA, Santiago, Chile
Robin Haighton, VE3FRH, Burlington, ON
Rick Hambly, W2GPS, Severna Park, MD
Paul Hise, AA9GY, Franklin, IN
Jim Huhta, AA4MD, Tampa, FL
Dee Interdonato, NB2F, Lodi, NJ
Jim Jarvis, N2EA, Pasadena, MD
Ed Krome, K9EK, Columbus, IN
Roger Ley, WA9PZL, Bossier City, LA
Nancy Makley, KC8GYW, Dayton, OH
Jerry Malin, N2HV, Matthews, NC
Robert McGwier, N4HY, East Windsor, NJ
Chuck Pinkham, K3PER, Annapolis, MD
Mal Preston, NP2L, Cruz Bay, VI
Jim Prokup, KC8RAN, Parma Heights, OH
Keith Pugh, W5IU, Ft. Worth, TX
Jim Randall, N3YDT, Gaithersburg, MD
Jim Sanford, WB4GCS, Eighty Four, PA
Martha Saragovitz, Silver Spring, MD
Dieter Schliemann, KX4Y, Scottsboro, AL
Gould Smith, WA4SXM, Knoxville, TN



IC-910H



The final frontier suddenly got a lot closer

Enjoy an extraterrestrial experience with the IC-910H. Satellite ops are where this rig really takes off! Downlink and uplink frequencies display simultaneously as the main and sub-bands on the large, easy to read screen. Normal/reverse tracking. Doppler shift compensation is a breeze. Unmatched power output for its size and exceptional Rx sensitivity gives you the power to reach those birds that others miss! The final frontier... it's as close as your authorized Icom dealer.

100W Variable Output • All Mode • Simultaneously Works Two Bands at Once • 9600 bps High Speed PACKET Port • .11 μ V Sensitivity • Main & Sub Band Functions for IF Shift, Sweep, NB, RF Attenuator • Large LCD Display • Four Versatile Scanning Functions • CTCSS Encode/Decode/Tone Scan • Built-in Keyer • PC Controllable • Memory Pad • Normal/Reverse Satellite Functions



AG-2400

Downlink Receive Converter

Converts a 2400MHz RF signal to a 144MHz IF signal, allowing US mode operation. When used with optional UX-910, LS mode operation is also available.



UT-106

DSP Unit

Provides AF-DSP (Digital Signal Processing) functions, including noise reduction and automatic notch filter. Use two, one for main band & one for sub-band.



UX-910

1200MHz Band Unit

Turns the IC-910H into an all mode, tri-band transceiver. Also makes crossband and full duplex operation possible.

Out of this world!

www.icomamerica.com

ICOM